Using annual ecosystemic multispecies surveys to assess biodiversity in the Gulf of St. Lawrence

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2015

Canadian Technical Report of Fisheries and Aquatic Sciences 3149

Fisheries and Oceans Canada   Pêches et Océans Canada

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Canadian Technical Report of Fisheries and Aquatic Sciences

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Canadian Technical Report of
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Cat. No. Fs97-6/3149E-PDF ISBN 978-0-660-03908-4 ISSN 1488-5379

Correct citation for this publication:

Nozères, C., Bourassa, M.-N., Gendron, M.-H., Plourde, S., Savenkoff, C., Bourdages, H., Benoît, H., and Bolduc, F. 2015. Using annual ecosystemic surveys to assess biodiversity in the Gulf of St. Lawrence. Can. Tech. Rep. Fish. Aquat. Sci. 3149: vii+126 p.

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ABSTRACT

Nozères, C., Bourassa, M.-N., Gendron, M.-H., Plourde, S., Savenkoff, C., Bourdages, H., Benoît, H., and Bolduc, F. 2015. Using annual ecosystemic surveys to assess biodiversity in the Gulf of St. Lawrence. Can. Tech. Rep. Fish. Aquat. Sci. 3149: vii+126 p.

Important areas for biologically diverse communities were identified for the first time using data from ecosystem surveys including bottom trawl and plankton net sampling as well as seabird observations in the Northern and Southern Gulf of St. Lawrence. Taxonomic richness was examined by group for demersal fish, benthic invertebrates, pelagic taxa (fish and invertebrates), zooplankton, and seabirds. Benthic invertebrates and zooplankton were the most diverse groups (>100 taxa), followed by demersal fish, with 67 taxa consistently recorded from both regions. Pelagic taxa were incidental in trawl captures and of partial use in analyses. Up to 39 taxa of seabirds were observed from transects on the trawl surveys. The analyses showed several areas of high taxon richness located in regions broadly similar to previous reviews while making using of more recently available samples and taxonomic data. Combining all group layers indicated sectors with high overall taxonomic richness located in both deep (Laurentian Channel) and nearshore (Mingan, Belle Isle, Chaleur Bay, Shédiac, Cape Breton) areas in the Gulf and Estuary (head of channel, Manicouagan, Gaspé Peninsula).

RÉSUMÉ

Nozères, C., Bourassa, M.-N., Gendron, M.-H., Plourde, S., Savenkoff, C., Bourdages, H., Benoît, H., and Bolduc, F. 2015. Using annual ecosystemic surveys to assess biodiversity in the Gulf of St. Lawrence. Can. Tech. Rep. Fish. Aquat. Sci. 3149: vii+126 p.

Des aires importantes de biodiversité des communautés ont été identifiées pour la première fois à l'aide des données récoltées lors des relevés écosystémiques incluant l'échantillonage au chalut de fond et au filet à zooplancton, et des observations d'oiseaux marins dans le nord et le sud du golfe du Saint-Laurent. La richesse taxonomique a été estimée par grands groupes, i.e. les poissons démersaux, les invertébrés benthiques, les invertébrés/poissons pélagiques, le zooplancton et les oiseaux marins. Les invertébrés benthiques et le zooplancton présentaient la plus grande richesse taxonomique (>100 taxons), suivis des poissons démersaux avec 67 taxons identifiés dans les deux régions. Les espèces pélagiques étant principalement considérées comme prises accidentelles avec le chalut de fond, elles étaient donc plus marginales dans les analyses. Jusqu'à 39 taxons d'oiseaux marins ont été observés à partir des transects des relevés au chalut. Les analyses ont montré plusieurs zones de forte richesse taxonomique localisées globalement similaires aux évaluations antérieures basées tout en utilisant des échantillons et des données taxonomiques plus récentes. La superposition de toutes les couches de groupes a montré une grande richesse taxonomique globale localisée à la fois dans les zones profondes (chenal Laurentien) et les zones côtières (Mingan, Belle Isle, la baie des Chaleurs, Shédiac et Cap-Breton) dans le golfe et l'estuaire (tête du chenal, Manicouagan, Gaspésie).

1. INTRODUCTION

The Gulf of St. Lawrence has been designated as a Large Ocean Management Area (LOMA), for integrated management and planning purposes by Fisheries and Oceans Canada (DFO) according to the principles of Ocean Act (DFO 2009) (Figure 1). Various initiatives are underway to identify important or vulnerable areas that support essential functions in the ecosystem; these are to be managed within an established network of marine protected areas (MPAs). This process is aided by the review of information from both physical and biological components, which provide the context to better understand patterns of species observed from surveys. The physical components are briefly summarized here prior to the analysis of species data.

Physical environment

The Gulf of St. Lawrence is a highly stratified, semi-enclosed sea connected to the North Atlantic Ocean by Cabot Strait to the south and the Strait of Belle Isle to the north (Koutitonsky and Bugden 1991). The bathymetry of the Gulf is dominated by the Laurentian Channel, which divides the Gulf into two distinct systems: the Northern Gulf (NGSL), with several channels having depths greater than 200 m, and the Southern Gulf (SGSL), represented by a shallow shelf with depths mostly less than 100 m. The boundary between the two regions is usually considered the 200 m depth contour of the Laurentian Channel between Gaspé and Cape Breton (Dutil et al. 2011).

In the Northern Gulf, the Laurentian Channel starts at the Atlantic Ocean margin and enters the Gulf through Cabot Strait before branching into the St. Lawrence Estuary to the northwest and Esquiman Channel to the northeast. A branch of Esquiman Channel—Anticosti Channel—separates Anticosti Island from the north shore of the Gulf. The Northern Gulf is affected by the inflow of warmer water through Cabot Strait and colder water from the Labrador Shelf through the Strait of Belle Isle (El-Sabh 1975, Wu et al. 2012).

The study area of the Northern Gulf extends west into the St. Lawrence Estuary. An abrupt drop in the Laurentian Channel from 50 to 300 m over 20 km, near the confluence of the St. Lawrence and the Saguenay rivers, serves as a boundary for the upper and lower estuary. The study area in the upper estuary is increasingly brackish as it extends westward to Quebec City; however, research surveys were limited to the lower estuary, which is mostly marine.

The Southern Gulf region is a productive area with three main zones dominated by a shallow plateau. The nearshore area has the highest surface temperatures in the study area, while a large part of the central plateau coincides in depth with a cold intermediate layer of water, resulting in bottom temperatures near or below 0°C during summer months. Bottom temperatures increase with depth in the slope area toward the deep Laurentian Channel (Galbraith et al. 2013).

Physical habitats

The complex geomorphology, bathymetry, and hydrology of the Gulf allow it to be subdivided into several geographical zones. Recently, a spatial framework was established to classify seafloor habitats on a grid of 10 × 10 km cells in the Gulf (Dutil et al. 2011). A range of physical variables including depth, slope, salinity, oxygen saturation, and temperature were processed using cluster analysis, resulting in 13 megahabitat groups of deepwater channels, slopes, and shelves. The water column is also host to a range of pelagic habitats that may be structured by coastlines, currents, and exchanges of water bodies from adjoining areas.

Ecologically and biologically significant areas

The marine biological components of the Gulf of St. Lawrence range from plankton to macroinvertebrates, free-swimming fishes, marine mammals, and seabirds. By considering their uniqueness, concentration of biological components, and ecosystem function (DFO 2004), a suite of ecologically and biologically significant areas (EBSAs) have been identified for the Gulf of St. Lawrence (DFO 2007). However, some areas previously designated by experts have not been selected due to a lack of data (Savenkoff et al. 2007). Multispecies trawl surveys of demersal fish and invertebrate abundance and biomass have been conducted annually by Fisheries and Oceans Canada, for more than four decades in the case of the SGSL (Savoie et al. 2012, Archambault et al. 2013). Since 2002 in the NGSL, additional information has become available through increased efforts for non-commercial fishes and invertebrates (Nozeres and Bérubé 2003, Lévesque 2009, Nozères et al. 2010, Bourdages and Ouellet 2011, Nozères et al. 2014). For zooplankton, sampling on surveys began in 1999 in the SGSL and 2006 in the NGSL. More recently, the monitoring of seabirds was conducted during the surveys in 2012 and 2013. The offshore distribution of biological habitats for the groups of zooplankton, fish, invertebrates, and seabirds recorded on these surveys may now be examined throughout the Gulf.

Objectives

The aim of the project was to analyze recently available biological data and identify areas that represent high levels of biodiversity in the Gulf of St. Lawrence. Data from Northern and Southern Gulf regional surveys between 2006 and 2013 were examined and standardized for groups of zooplankton, benthic macroinvertebrates, demersal fish, pelagic taxa (fish and macroinvertebrates), and seabirds. The reliability of taxonomic records was evaluated to determine the species subgroupings of greatest use and also to indicate those in need of further review. Taxon richness (number of taxa by station) was examined for each of the groups, and their spatial distribution was used to identify areas that had samples with high richness. The updated information will serve to support further calculations of biodiversity metrics and to perform multivariate analysis of ecological communities. Because biodiversity is one of the primary management objectives of the MPA network planning, decisions for creating MPAs in the Gulf of St. Lawrence would benefit from this new information for surveyed areas. The analyses will also bring to attention those areas with sparse information. Finally, the process of data review undertaken here may help other agencies to conduct similar exercises to integrate more biological layers into their datasets for large-scale spatial analyses.

2. MATERIAL AND METHODS

2.1. DATA SOURCES

Data from the Northern (NGSL) and Southern (SGSL) Gulf surveys were treated separately because of differences in sampling gear and methods between the regions. The biological layers used for the spatial analysis of diversity were fish, invertebrates, zooplankton, and seabirds (Table 1). Fish and invertebrates were sampled from 2006 to 2012 during regular multidisciplinary research surveys that took place annually in August for NGSL and September for SGSL. The survey, which covers approximately 200 stations annually, follows a random stratified sampling design based on depth strata; missions took place on the research vessel CCGS *Teleost* (Figures 2 and 3). For NGSL, sampling occurred between 37 and 510 m of depth with a Campelen 1800 shrimp bottom trawl and a 12.7 mm mesh codend lining (Archambault et al. 2013). In the Southern Gulf, stations were between 15 and 350 m and were sampled with an Atlantic Western IIA bottom trawl and a 19 mm mesh codend lining (Hurlbut and Clay 1990, Savoie et al. 2012). Survey stations from south of Cabot Strait (strata 440, 441, 442) were excluded. Occurrence records from DFO surveys are available on the Ocean Biogeographic Information System website (OBIS; http://www.iobis.org). For the Gulf of St. Lawrence, the records are listed as *datasets* under *OBIS Canada* for *DFO Quebec Region Multispecies bottom trawl surveys* (Northern Gulf fish taxa only) and for *DFO Gulf Region Groundfish Research Vessel Surveys* (Southern Gulf fish and invertebrate taxa).

Zooplankton has been sampled in both regions every year since 2006; however, the full taxonomic analysis necessary for this exercise was available in both regions only for 2006 and 2007. Sample processing followed the Atlantic Zone Monitoring Program (AZMP) sampling protocol (Mitchell et al. 2002), with details given in Plourde et al. (2009). Northern Gulf samples were collected from 128 stations on the August multispecies survey (Figure 4A). Southern Gulf zooplankton samples were collected from 17 stations each year on the September survey, excluding one station south of Cabot Strait in 2006, for a total of 33 stations (Figure 4B).

Seabirds were monitored during the trawl surveys on the CCGS *Teleost* in 2012 and 2013, for a total of 609 samples in the Northern Gulf and 350 samples in the Southern Gulf (Figure 5). Samples are represented by the number of spatial grid cells in a survey area that contained a observational transect. The Canadian Wildlife Service of Environment Canada was responible for data management and scientific resources for the seabird datasets.

2.2. TAXONOMIC STANDARDIZATION

Data review process

Capture records from bottom trawl surveys included a wide range of fish and invertebrate taxa beyond the targeted commercial species. Some taxa may be uncommon or of limited value (e.g., poor condition, fragments, extralimital strays). In addition, efforts at identifying and recording captures of non-target taxa varied between years, depending on survey resources and objectives. Thus, the records were reviewed to determine their utility for particular analyses. An example workflow for capture data validation for fishes and macroinvertebrates is shown below:

Stage 1: Total checklist (initial cleanup based on recorded names)
1) Review taxonomic names (misspellings, synonyms, duplicates);
2) Review invalid or outdated taxonomic levels (e.g., "invertebrate");
3) Verify plausible identifications, preferably by consulting regional species checklists.

Stage 2: Survey species (reducing inappropriate taxa based on occurrences)
1) Examine for systematic bias between survey years (i.e., rare species that may be misidentified as common species; general level records that may refer to single species);
2) Exclude rare (e.g., one or two records only) or incidental taxa (e.g., nearshore species);
3) Exclude general taxonomic levels such as family or genus when all species are presented (e.g., a few records of Agonidae were discarded if all three species were recorded).

Stage 3: Spatial distribution (analyzing robust sample records)
1) Exclude taxa not reliably sampled by bottom trawl (e.g., mesopelagic, seasonal);
2) Exclude records at inappropriate sites for the species (spatial coordinates or depths) that likely result from sample contamination due to abundant species remaining in net mesh between stations (e.g., brittlestars, sea pens, softpouts, grenadiers, barracudina);
3) Examine biological suitability of records within taxa (e.g., nearshore juvenile pelagic vs offshore adult demersal classes of fishes and invertebrates).

The review workflow produced datasets that were managed as worksheets or tables at several stages (see Appendices 1–4). Reviewing data also depended on the taxonomic group or the type of analyses. For zooplankton, grouping and review was conservative, maintaining as many as of the originally listed taxa as possible, whereas fish and macroinvertebrate taxa with known issues were edited. For this study, diversity was only evaluated with station (sample) richness, therefore only presence information was used, although abundance and biomass values were also available. When working with presence information, reliable identifications of even rare species are important at each station. In other studies, when using abundance or biomass, the analyses are restricted to common taxa, of well-known species or higher taxonomic levels, thus avoiding issues with problematic and rare taxa records (see for example Chouinard et al. 2014, Moritz et al. 2013, Rooper et al. 2014).

Group layer review

Each of the biological group layers has particular information by region that may be of assistance when selecting and using the available records. The general taxonomic issues are summarized below.

Fish records from the Northern Gulf surveys have undergone a series of reviews, with identifications from 2006 onwards generally considered as reliable (Dutil et al. 2006). The Southern Gulf survey has had integrated monitoring of non-commercial species of fish for many years, and only a few records remain uncertain from the usual problematic taxa of eelpouts, snailfishes, and sculpins (Benoît et al. 2003). While sculpins were presented here by species, it may be preferable to group these taxa to the genus level (e.g., *Artediellus*, *Icelus*, *Myoxocephalus*, *Triglops*) for other analyses (Benoît 2006). The beaked redfishes, *Sebastes fasciatus* and *S. mentella*, are very difficult to separate visually, although individuals in captures may be separated based on station depth and anal fin softray counts (if available). In the datasets, *S. fasciatus* and *S. mentella* were recorded to genus in both regions. Regional fish species checklists included the DFO Quebec Region code list (Miller and Chabot 2014), the Gulf of St. Lawrence checklist (Miller 2013), and the Annotated Checklist of Fishes of Canada (Coad 2013).

Apart from commercial species, efforts to identify benthic macroinvertebrates in trawl captures have varied over the years, depending on available expertise or special sampling requests. A first guide was produced in 2003 to document the species in Northern Gulf trawl captures on the CCGS *Alfred Needler* (Nozères and Bérubé 2003). The *Teleost* surveys that began in 2004 used different gear with a smaller net lining mesh (13 vs 19 mm) and collected a greater variety of smaller fishes and invertebrates. Concentrated efforts were undertaken between 2006-2009 to identify the benthic invertebrate megafauna collected in the trawl, and these are now included in the regular survey sampling protocol (Lévesque 2009). In 2011, a request for sea pen (order Pennatulacea) samples led to the identification of the four species present in the Gulf (Nozères et al. 2014). For several groups, such as tunicates (class Ascidiacea), ongoing reviews will enable further species to be documented. At the present time, records that were difficult to resolve were excluded or placed into groups at a higher taxonomic classification. The colonial, sessile (fixed) species of Hydrozoa and Bryozoa are difficult to identify while at sea, and the samples often consisted of fragments or traces (dead debris) attached to other organisms or hard surfaces, and therefore these groups were excluded from the analyses. Other benthic invertebrate species may be either too small (< 2 cm) or fragile to be collected by the trawl net and thus were not recorded in captures.

To review the names of invertebrates, the St. Lawrence marine invertebrate catalogue by Brunel et al. (1998) and the DFO Quebec Region taxonomic code list (Miller and Chabot 2014) served as regional species checklists. Taxonomic names were initially evaluated using the *Integrated Taxonomic Information System* website (ITIS.org). While fish species names were sufficiently covered by ITIS, the taxonomy of marine invertebrates requires more effort, and therefore all taxon names were matched to their currently accepted synonyms and classifications using the *World Register of Marine Species* (WoRMS, 2015).

Each taxonomic name has a unique serial number, referred to as TSN in ITIS and AphiaID in WoRMS. Both regions also attribute their own code numbers for each taxon.

The bottom trawl surveys target the sampling of demersal (near-bottom) and epibenthic species. Nominally pelagic species may also be collected incidentally during the descent and ascent of the trawl in the water column during a tow, or when populations occur near the bottom. Because of this difference in catchability, the fish and invertebrate layers were divided into benthic (or demersal) and pelagic groups. The pelagic group included epipelagic (surface to 200 m depth) and mesopelagic (>200 m depth) species. The principal macroinvertebrates in the pelagic group were northern shortfin squid (*Illex illecebrosus*) and large jellyfishes. Also included in this group were the bentho-pelagic species of sand lances (*Ammodytes* spp.), lumpfish (*Cyclopterus lumpus*), Atlantic softpout (*Melanostigma atlanticum*), and pink glass shrimp (*Pasiphaea multidentata*). Sandlance and lumpfish are epipelagic fish when offshore, and were only occasionally captured by the bottom trawl. In contrast, the mesopelagic softpout and glass shrimp were frequent in deepwater (200 m or more depth) trawl captures. Softpout may be spawning in the bottom sediment during the summer (Silverberg et al. 1987), while glass shrimp form benthic populations as adults, making them available to the bottom trawl (Company et al. 2011). Macrozooplankton (euphausiids, hyperiid amphipods, comb jellies, and small hydrozoan medusae) were also occasionally abundant and recorded in the trawl captures; these were excluded from the pelagic group, being represented already by the zooplankton group layer.

The zooplankton samples comprised meso- (small and large; <5 mm length) and macrozooplankton (excluding copepods; >5 mm). The relatively small surface area and slow speed of the plankton net resulted in few captures of the larger macrozooplankton, for example, juvenile fish, decapod larvae, and medusae. To prepare for analysis, eggs and larvae were grouped together for krill (Euphausiidae) and fish (Actinopterygii), while copepod eggs and larvae (nauplii) and unspecified invertebrates were discarded.

A number of marine bird taxa were observed as species, genus, or similar species grouped together. Because of the varying length of transects, standardization for observed area was performed, resulting in data having near median values (approximately 5 km^2).

2.3. SPATIAL ANALYSIS

Spatial analyses as a series of maps for both northern and southern regions were produced using ESRI ArcGIS software (version 9.3) with the Spatial Analyst extension. For the first series, all taxa (except birds) had the sum of their occurrences weighted. This was done by summing the count of taxa from each station and dividing by the number of stations located in cells of a 10 × 10 km (100 km^2) grid, as defined in the St. Lawrence habitat atlas (Dutil et al. 2011). For the maps, the average values were binned into quartiles, indicating low (0–25%) to high (75–100%) taxon areas for each group layer.

A finer-scale analysis (2.5 × 2.5 km grid) was produced using interpolation. The average value of station taxa per cell was aggregated to the centroid of the cell and then interpolated for a distance of 2.5 km (natural neighbour). A spatial mask was applied prior to interpolation to reduce the influence of values from distant stations. For fish and invertebrates, the limits were taken from the survey strata in which the stations were sampled; this excludes the upper Estuary, Mécatina Trough on the Lower North Shore, the western portion of Northumberland Strait, and nearshore areas near the Îles de la Madeleine (Magdalen Islands) and Newfoundland. A distance of 50 km was used for zooplankton stations because their spatial distribution was considered relatively homogenous, following surface water circulation. The Southern Gulf had three of four zooplankton stations in Cabot Strait located outside but near (<10 km) the mask limit. These were retained for interpolation because of the sparseness of data for zooplankton. The mask limit for birds was fixed at 20 km, which represents the maximum distance for human observation in the database. As with the mean values on the 10 km grid, the interpolated values were presented in binned quartiles.

A final map was generated by integrating the interpolated areas of the five data layers, using the trawl survey area as the spatial limit, adjusted for the limited nearshore coverage of the zooplankton layer. To combine the groups, taxon richness was normalized from 0 to 1 for each layer and then summed, with the upper 75th percentile being mapped for areas of 25 km^2 or more.

2.4. SAMPLING EFFORT AND TAXON ACCUMULATION

The adequacy of the surveys to document the taxa in each of the regions was evaluated by 1) mapping sampling effort for all groups by cell of the 100 km^2 spatial grid and 2) plotting taxon accumulation curves for each group, except pelagic taxa. The pelagic group comprised several taxa with uncertain catchability and was therefore not suitable for examination using accumulation curves.

Examining sampling effort is important because of the large scale and number of grid cells covering the study area. In addition, unlike biomass and abundance values, taxon richness increases in a non-linear fashion with the number of samples (Gotelli and Colwell 2001, Ugland et al. 2003, Kenchington and Kenchington 2013). As a result, reporting summed or mean values of station richness may give misleading results. For this study, the maps of mean and interpolated sample richness are intended as a general tool, to explore the groups and spatial areas for further analysis. To help make use of the richness maps, it is useful to identify those areas with high and low (or no) sampling. The intensity of sampling effort was shown here by summing all stations in a grid cell for each group, except birds. For bird observations, a cell could contain several transects, with identical but non-continuous orientation. These segments may not be independent, and counting each of them could have overestimated the effort. Consequently, the effort was calculated considering the day when the transect was done.

With continued sampling, taxon richness in a survey region will accumulate, ideally until the total number of taxa is recorded. A taxon accumulation curve plotted over stations indicates the adequacy of sampling in a region. Sufficient sampling effort occurs when the curve approaches an asymptote. If an asymptote is not achieved, the total number of taxa is not known with the given samples, suggesting the need for future work to refine the group under study, obtain more samples, or to extrapolate. For each group, the curve was calculated on the occurrence (presence/absence) matrix of taxa by station using the *specaccum* function in the *vegan* package (Oksanen et al. 2015) of R software (version 3.1, R Core Team 2014). For seabirds, the curves were calculated using transect length per grid cell because the sampling units were transects rather than stations. This was performed with the *BiodiversityR* package using the functions *accumresult* and *accumplot* (Kindt and Coe 2005).

3. RESULTS

3.1. TAXONOMIC DIVERSITY

Lists of total taxon richness are summarized here for the Northern and Southern Gulf regions as demersal fish, pelagic fish, benthic invertebrates, pelagic invertebrates, zooplankton, and seabirds (Table 2).

Northern Gulf

Demersal fish

The bottom trawl surveys sampled from 2 to 21 demersal species per station (mean = 11.8), for a total of 67 species in the NGSL. The captures ranged from commercial species such as flounders, codfishes, and redfishes, to nearshore and deepwater species such as sculpins, blennies, snailfishes, and eelpouts (Table 3). Occasional captures included species that may be near the limits of their range in the NGSL, such as the Arctic alligatorfish (*Aspidophoroides olrikii*) near the Strait of Belle Isle, and haddock (*Melanogrammus aeglefinus*), more commonly associated with the Scotian Shelf located to the south. Some species required considerable effort to identify, particularly for smaller specimens (<20 cm) of cod and eelpouts, and were recorded to the genus level. Other species were positively identified, but only present as incidental captures, including pelagic juveniles of threebeard rocklings (*Gaidropsarus* spp.) and the inshore Atlantic tomcod (*Microgadus tomcod*). Very rare captures included one specimen each of Northern wolffish (*Anarhichas denticulatus*) and the southern species, blackbelly rosefish (*Helicolenus dactylopterus*). In all, 56 species and the genus *Sebastes* (*S. fasciatus, S. mentella*) were selected for analysis.

Pelagic fish

A total of 35 epipelagic and mesopelagic fish were sampled in the northern region, with captures of 0 to 7 taxa (mean = 2.8) by station. The most common species were capelin (*Mallotus villosus*), Atlantic herring (*Clupea harengus*) and mesopelagic (>200 m depth) white barrucudina (*Arctozenus risso*) and Atlantic softpout. In all, 13 species and one genus (*Ammodytes* spp.) were deemed useful for analysis (Table 4). Nearshore (e.g., *Osmerus mordax*) and deepwater taxa were excluded. The latter were infrequently sampled and usually damaged by the bottom trawl, making it difficult to record their presence, both in terms of sample location and taxonomy. These included lanternfishes (Myctophiformes: Myctophidae and Neoscopelidae) and lightfishes (Stomiiformes: Gonostomatidae), along with rare and solitary species such as hatchetfishes (Stomiiformes: Sternoptychidae) and sea devils (Lophiiformes: Ceratiidae).

Several pelagic species commonly seen in the Atlantic Ocean to the south were occasionally captured in small numbers on the surveys, including spiny dogfish (*Squalus acanthias*), Atlantic saury (*Scomberesox saurus*), silver hake (*Merluccius bilinearis*), and pollock (*Pollachius virens*) Another visiting pelagic fish was Arctic cod (*Boreogadus saida*), presumed to be entering the Gulf from Labrador through the Strait of Belle Isle.

Sand lances (*Ammodytes* spp.) represent a special case. Two species are present in the Gulf, *A. americanus* and *A. dubius* (Winters and Dalley 1988, Nizinski et al. 1990, Brêthes et al. 1992). The latter species usually occurs offshore, but otherwise distinguishing the two species is very difficult and was only performed in 2012, with all other captures recorded to the genus. Sand lances are semi-demersal and prefer to school over shallow (30–80 m) sandy areas that they burrow into for shelter. Sandy areas are uncommon in the Northern Gulf, and sand lances were very rarely captured on surveys.

Benthic invertebrates

The benthic layer had the highest total diversity (148 taxa) of all groups on the northern surveys. Following review, 98 taxa were retained for analysis (Table 5). Each station had from 0 to 38 taxa (mean = 13.4), mostly of macrofaunal species occurring near (suprabenthic; e.g., *Pandalus* shrimps and amphipods) or on (epibenthic; e.g., sea stars and anemones) the bottom. Some taxon groupings had frequent records and contained a known number of species, but were only identified to higher classes in most years, in particular phylum Cnidaria, with eight species of anemones (class Actiniaria) and four species of sea pens (order Pennatulacea).

In some cases, taxon groups remained diverse even when analyzed at the genus or family levels, such as the gastropod and bivalve molluscs, for which over 40 taxa were documented. However, several molluscan records were problematic, either because of taxonomic confusion—in particular the whelks of family Buccinidae—or possibly due to the stray presence of shells from coastal species such as clams (Bourdages et al. 2012). Other molluscs presented a challenge due to the lack of identification resources for the offshore species in the region. Examples included deepwater nudibranchs (*Colga villosa, Doridoxa ingolfiana*), vitreus scallop (*Similipecten greenlandicus*), and cephalopods (*Bathypolypus bairdii, Rossia* spp.), all of which were prone to misidentifications for several years (Nozères and Bérubé 2003, Nozères et al. 2014).

Crustaceans presented few issues, apart from the highly diverse amphipods (Brunel et al. 1998). Only seven amphipod taxa were regularly identified in the benthos, not including the pelagic hyperiids (i.e., *Themisto libellula, Hyperia galba*). Several species (e.g., *Epimeria loricata, Paramphithoe hystrix, Stegocephalus inflatus*) may be associated with sponges (phylum Porifera) and sea pens (order Pennatulacea) that were also found in captures. Among decapods, 19 shrimp species were frequent in captures, with an additional six species in a few records, corresponding to mesopelagic oceanic species and listed here in the pelagic group layer. The common sand shrimp (*Crangon septemspinosa*) was only seen once; this species is restricted to inshore waters and was not considered here. Two small, deepwater decapods were also present: a galatheid crab (*Munidopsis curvirostra*) and the mud lobster (*Calocaris templemani*). The latter is a burrowing species and was very rarely recorded in captures, thus it was not used in analyses. Deepwater samples also revealed two species of bentho-pelagic isopods, considered as facultative parasites: *Syscenus infelix* feeds on a grenadier fish (*Nezumia bairdii*) and *Aega psora* on other fishes (Hemmingsen and MacKenzie 2001, Ross et al. 2001). Both species can be free-living and may be active swimmers. They were classified here with the benthos due to their close association with demersal fishes but were excluded from further analysis.

Most of the large-sized (>10 cm) echinoderm species residing in the Northern Gulf have been recorded in the trawl captures, apart from an inshore species, the common sea star (*Asterias rubens*). Records of this species were all misidentifications for other five-armed sea stars of family Asteriidae, (e.g., *Urasterias linckii*). The small brittlestars of order Ophiurida were occasionally very abundant, making it difficult to record the presence of each species in the capture, resulting in their frequent grouping to class Ophiuroidea. The large basketstars (*Gorgonocephalus* spp.) of order Euryalida were not included in the groupings under class Ophiuroidea. Ophiurid brittlestars were dominated by *Ophiura sarsii* in the soft-bottom channels and *Ophiopholis aculeata* in rocky areas. Other confirmed species include *Ophiacantha bidentata* and *Ophioscolex glacialis*, while several smaller species remain to be verified (Nozères et al. 2014).

A number of very diverse benthic groups were only coarsely identified, such as phyla Bryozoa, Nemertea, and Sipuncula, along with classes Ascidiacea, Hydrozoa, and Polychaeta. Many specimens were fragile and also required magnified examination by specialists to identify to the species. Fragments of colonial taxa like bryozoans and hydrozoans, and groups of barnacles (Crustacea: Cirripedia), were also difficult to evaluate for their biomass or even their presence at a given tow station. In some instances, calcareous debris from shallow-water bryozoans has been mistaken for deepwater coral species. As a result, these phyla and classes were excluded from analyses except for selected large (>10 cm) species. These included the solitary ascidians of sea potato (*Boltenia ovifera*) and sea peach (*Halocynthia pyriformis*), large barnacles (shallow-water *Chirona hameri* and deepwater *Arcoscalpellum michelottianum*), and a polychaete worm, the sea mouse (*Aphroditella hastata*).

The benthic taxa in captures were mostly from deepwater and soft-sediment habitats, which were the most common bottom habitat types in the region (Dutil et al. 2011). A few stations at very deep (>400 m) sites revealed the solitary cup coral (*Flabellum alabastrum*), the only species of hard coral (Scleractinia) catalogued in the Gulf (Brunel et al. 1998). Other species associated with inshore or hard bottom habitat types were rare in trawl samples, such as the holothurid, scarlet psolus (*Psolus fabricii*), and chitons (class Polyplacophora).

Pelagic invertebrates

Fourteen taxa of pelagic invertebrates were recorded in the northern surveys, with four taxa retained for analysis (large jellyfishes, two shrimps, one squid; Table 6). Stations had 0 to 4 taxa (mean = 1.3). Large jellyfishes were common as pelagic captures, usually recorded to the class Scyphozoa. When identified, three colourful scyphozoan species were common: the lion's mane jellyfish (*Cyanea capillata*) and two mesopelagic species, Wyville's crownjelly (*Atolla wyvillei*) and the merchant-cap (*Periphylla periphylla*). The moon jelly (*Aurelia aurita*), a colourless scyphozoan, was occasionally noted. A smaller (<10 cm diameter) and colourless jelly of class Hydrozoa (*Ptychogena lactea*) was frequent, but not often recorded. As was the case with the other cnidarians grouped here by class (Actiniaria and Pennatulacea), the presence of individual species was confirmed from the survey image database, even when not recorded by weight or number in the survey capture database (Nozères et al. 2014). Also seen in the trawl samples were macrozooplankton species, consisting of krill (mostly *Meganyctiphanes norvegica*), hyperiid amphipods, and a ctenophore (*Pleurobrachia pileus*). As documented in the methods, these were excluded from the pelagic layer analysis.

Occasionally captured from the deepwater layer were several species of mesopelagic shrimps near the southern entrance to the Gulf at Cabot Strait. A number of deepwater shrimp species are encountered in the Atlantic off the continental shelf (MacIsaac 2011). A few specimens of some species (*Acanthephyra pelagica, Eusergestes arcticus, Sergia robusta, Pasiphaea tarda*) have been captured in the Gulf, mostly since 2011, including two new species records (*Hymenopenaeus debilis, Plesionika martia*) associated with southern waters (Savard and Nozères 2012). The exception was the pink glass shrimp (*P. multidentata*), which was frequent in the Laurentian Channel and at the heads of the Anticosti and Esquiman channels (Savard and Nozères 2012).

Two species of cephalopod molluscs were also captured as pelagics. A deep-sea octopod, the glowing sucker octopus (*Stauroteuthis syrtensis*) was very rare. More frequent in captures was the northern shortfin squid (*Illex illecebrosus*), which migrates to the Gulf in the summer, likely feeding on krill and capelin, similar to other warmwater seasonal pelagics such as silver hake and pollock. Records of a southern species, the longfin squid (*Doryteuthis* [=*Loligo*] *pealii*), were misidentifications of the shortfin squid, as has also been observed in historical records (Mercer 1970). A coldwater species, the boreal armhook squid (*Gonatus fabricii*), has been captured on the surveys, but only as juveniles at the northernmost sites off of Labrador and outside the Gulf proper.

Southern Gulf

Demersal fish

Many of the shallow and coldwater demersal species captured on the southern surveys were also found in the Northern Gulf (Table 7). A total of 67 taxa were captured, with 52 being retained for analysis. Stations had 1 to 21 demersal taxa (mean = 8.6). Flatfishes and skates were frequent in the catches, with the addition of windowpane (*Scophthalmus aquosus*) and winter skate (*Leucoraja ocellata*), which were not found on the northern surveys, and greater captures of yellowtail flounder (*Limanda ferruginea*). Other differences included the presence of cunner (*Tautoglabrous adspersus*) and more frequent captures of Arctic alligatorfish (*Aspidophoroides olrikii*), a shallow coldwater species, and longhorn sculpin (*Myoxocephalus octodecemspinosus*), an inshore southern species. Deepwater species were the same as those found on the northern surveys, with several being excluded here as being either too rare (only one or two records) or in need of review (shallow-water sites).

Pelagic fish

Twenty-five pelagic fishes were recorded, with 17 used for analyses. Stations had 0 to 6 taxa (mean = 1.4). Several species were encountered in both regions, with more frequent occurrences in Southern Gulf surveys for warmwater and nearshore species (Table 8). These included mackerel (*Scomber scombrus*), American shad (*Alosa sapidissima*), and rainbow smelt (*Osmerus mordax*). Also more frequent was northern sand lance (*Ammodytes dubius*). Sand lance is found in schools in the water column or taking refuge on sandy bottoms, a habitat type more widely available in the southern region. Species in the Southern Gulf not recorded in the north were mostly inshore warmwater species such as Atlantic silverside (*Menidia menidia*) and butterfish (*Peprilus triacanthus*) along with the anadromous alewife or gaspereau (*Alosa pseudoharengus*) and Atlantic salmon (*Salmo salar*). Deepwater sites had captures of white barracudina, in addition to some records of lightfishes as were seen in the northern surveys and that were also excluded from further analyses: *Cyclothone microdon, Lampadena speculigera, Chauliodus sloani,* and *Stomias boa*. In the past, a few specimens of other barracudina species (e.g., *Magnisudis atlantica, Paralepis coregonides*) may have been captured, and thus barracudina may be recorded within family Paralepididae in the capture database (Benoît et al. 2003). For the current study, all specimens were assumed to be white barracudina (*Arctozenus risso*).

Benthic invertebrates

As in the northern region, the Southern Gulf surveys revealed a wide diversity of benthos, regrouped here from 137 to 72 taxa (Table 9). Stations had 1 to 28 taxa (mean = 13.2). At least 10 species of sponges (phylum Porifera) and several polychaete worms were identified in most years. In a few cases, anemones and corals (phylum Cnidaria) were also recorded to species, although these may need review. Other taxa are currently in the database at general levels, for example order Decapoda for shrimps. Data on decapod species composition are available and may eventually be included in the database. In an earlier review of benthic invertebrates (Chabot et al. 2007), the same shrimp species were shown to be present in both regions, with more occurrences of shallow-water species such as *Argis dentata* being found in the Southern Gulf.

As was seen in the northern region, molluscs (mostly gastropods and bivalves) accounted for much of the diversity. A number of large shallow-water bivalve species were only sampled in the Southern Gulf, including horse mussel (*Modiolus modiolus*), sea scallop (*Placopecten magellanicus*), propellerclam (*Cyrtodaria siliqua*), quahog (*Arctica islandica),* and surf clams (*Mactromeris polynyma, Spisula solidissima*). Several of the smaller species were infrequent or in need of review. The benthic cephalopods were once again a problematic group, having the same three species as encountered in the northern region, but with several captures being recorded generally as Octopoda or misidentified as *Semirossia tenera*. The latter is a southern sepiolid species seen in American reports and was misreported in an earlier guide of the St. Lawrence (Nozères and Berubé 2003), which has likely contributed to its misidentifications.

Species of large-sized invertebrates were similar in both regions, in particular the sea stars (*Crossaster papposus*, *Hippasterias phyrigiana*) and crabs (*Chionoecetes opilio, Hyas araneus, Hyas coarctatus, Lithodes maja, Pagurus* spp.). Sea cucumbers included two *Psolus* species (*P. fabricii, P. phantapus*) and the common species *Cucumaria frondosa*, although the latter was recorded as class Holothuroidea. Sea stars of Asteriidae, Poraniidae, basketstars (*Gorgonocephalus* spp.), and the smaller ophiurid brittlestars were also present in both regions.

Pelagic invertebrates

Large jellyfishes (class Scyphozoa) and the northern shortfin squid were the pelagic macroinvertebrates recorded in the southern region (Table 10). A single record of the longfin squid (*D. pealii*), was noted in 2011 near Cape Breton/Cabot Strait.

Zooplankton (both regions)

The zooplankton layer retained 125 taxa in 9 phyla from across the two regions, with a strong presence of crustaceans from 13 orders and 27 families that consist mostly of copepods (Table 11). The northern survey had a total of 102 taxa retained, with 16 to 45 taxa (mean = 28.6) recorded by station. The southern survey had 72 taxa retained, with 13 to 32 taxa (mean = 20) per station. High frequencies of the copepod *Oithona similis* and the hydromedusa *Aglantha digitale* were found in both regions, while the Northern Gulf had more of the calanoid copepods such as *Calanus finmarchicus*, *C. hyperboreus*, and *C. glacialis* and the Southern Gulf had inshore species such as the copepod *Tortanus discaudatus*. A number of hydrozoan jellies were identified in the Northern Gulf, along with pelagic amphipods associated with scyphozoan jellies (i.e., *Hyperia* spp.).

Seabirds (both regions)

A total of 46 seabird taxa (37 species) were recorded during surveys, with 38 taxa observed along 650 km of transects in the Northern Gulf and 36 taxa along 350 km in the Southern Gulf (Table 12). Most seabird taxa were observed fewer than 10 times. This was the case for 25 of 39 taxa in the north and 30 of 36 taxa in the south. The most frequently observed species was the northern gannet (*Morus bassanus*), with 27% of occurrences in the north and 46% in the south. The next most frequent species was the herring gull (*Larus argentatus*), with 17% of occurrences in the north and 14% in the south. The Atlantic puffin (*Fratercula arctica*) and the razorbill (*Alca torda*) were only observed in the Northern Gulf, whereas four of eight gull species (family Laridae) and two of three phalaropes species were only observed in the Southern Gulf. Rare observations of visiting species included the lesser black-backed gull (*Larus fuscus*) and the great skua (*Stercorarius skua*).

3.2. SAMPLING CONSIDERATIONS

Sampling intensity

The spatial grid of the study area is presented with cells coloured by sampling effort in Figure 6. Intensively sampled areas (up to 12 stations or transects: red cells), which were covered by both the Northern and Southern Gulf surveys, occurred along the southern slope of the Laurentian Channel (Figure 2). There were also high levels of sampling in the Estuary, at the entrance of Chaleur Bay, and in St. George's Bay (Nova Scotia). A number of cells in the Northern Gulf had no samples, corresponding to shelf areas to the west and east of Anticosti Island, and to the northeast near Beaugé Bank and the Strait of Belle Isle. These northern shelf areas were often rough bottomed and difficult to sample. Other cells located in the deep channels and Magdalen Shallows contained only a few stations. The trawl surveys follow a stratified random design based on depth and area, with the number of sampling sites in each stratum approximately proportional to the stratum area. Consequently, several areas of channel bottoms and shallows had relatively few stations dispersed across grid cells of the same depth layer.

Taxon accumulation curves

Northern Gulf

The curves for demersal fish and benthic invertebrates approached an asymptote after 100 samples (Figure 7A). Most fish species were recorded after 20 stations and invertebrates after 50 stations. Thus, sampling appeared sufficient to document the taxa encountered at stations for these groups in the NGSL when using the annual trawl survey. The zooplankton curve also increased rapidly, with about 70 taxa recorded by 20 stations, but more taxa were added even after 100 stations. The zooplankton curve slowed but did not reach an asymptote, indicating that further taxa would be added with more samples. The seabird curve using transects was more gradual than was seen with the other groups. Nearly half of the seabird taxa were recorded in 500 km of transects, with new records slowly being added with additional observations.

Southern Gulf

The southern surveys had the demersal fish and benthic curves again having most taxa recorded by approximately 20 and 50 stations, respectively, and nearing an asymptote by 100 stations, indicating the adequacy of the annual survey to sample these groups at the presented taxonomic levels (Figure 7B). The zooplankton curve rose gradually due to the lower number of stations, although the trend approached that of the northern survey, with over 60 taxa recorded by 20 stations. An asymptote was not clearly reached, and additional taxa could be expected with further sampling. The seabird curve presented a gradual accumulation trend, without a steep rise, similar to the northern survey. Additional taxa may be recorded with increased observations.

3.3. DISTRIBUTION OF TAXONOMIC RICHNESS

Bottom trawl surveys

Demersal fish

Several areas showed high demersal richness (up to 20 taxa per cell) in the Northern Gulf, in particular for Jacques Cartier Strait between the North Shore and Anticosti Island (Figure 8). Nearshore areas in the Estuary and near Cape St. George off of Newfoundland also showed high species richness. Low values (approximately 2 to 10 taxa) were seen in Anticosti Gyre and some areas of the deep channels.

The Southern Gulf had several large areas with high demersal richness: Chaleur Bay, off of the Gaspé Peninsula, between Prince Edward Island and the Îles de la Madeleine, and along the Cape Breton coast (Figure 9). Areas with lower species richness were located mainly to the northwest and southeast of the Îles de la Madeleine and in central Northumberland Strait.

Pelagic fish and invertebrates

High richness areas for pelagic fish and invertebrate taxa (approximately 5 to 9 taxa per cell) were found in the Laurentian Channel, including the Estuary and Anticosti Gyre (Figure 10). Elevated values (3 to 5 taxa) were also present in the Anticosti and Esquiman channels. Areas of low pelagic richness (0 to 3 taxa) were located along the west coast of Newfoundland and on the North Shore above Anticosti Island (Jacques Cartier Strait).

For the Southern Gulf, nearshore areas were highest in species richness (generally between 3 to 7 taxa per cell), between New Brunswick and Prince Edward Island, eastern Northumberland Strait, and northwest Cape Breton (Figure 11). High values were also recorded in the survey area along the southern slope of the Laurentian Channel. Areas of low pelagic richness (2 taxa per cell or fewer) were located throughout the Magdalen Shallows (central part of the SGSL).

Benthic invertebrates

In the Northern Gulf, high taxonomic richness for benthic invertebrates (generally over 16 taxa per cell) was observed in similar areas as for demersal fishes (Figure 12). These included the Estuary, Jacques Cartier Strait between Anticosti Island and the North Shore, and the west coast of Newfoundland up to the Strait of Belle Isle. Low richness areas (fewer than 10 taxa) were located in the deep channels, in particular Anticosti Gyre.

In the Southern Gulf, high taxonomic richness areas were also similar to those seen with demersal fishes, located between Prince Edward Island and the Îles de la Madeleine, from Chaleur Bay to offshore of the Gaspé Peninsula, along the northwest coast of Cape Breton (Figure 13). Low diversity values were seen for cells in central Northumberland Strait and areas of the Magdalen Shallows to the northwest and southeast of the Îles de la Madeleine.

Zooplankton

In the Northern Gulf, areas with high zooplankton richness (more than 33 taxa) were mainly located near Cabot Strait, extending into the Laurentian, Esquiman, and Anticosti channels (Figure 14). Other high-value areas were seen off of the northern shore of Gaspé Peninsula. Low richness areas (about 16 to 24 taxa) were located along the west coast of Newfoundland to the Strait of Belle Isle, in addition to other shallow shelves along the North Shore and around Anticosti Island.

In the Southern Gulf, areas with high zooplankton richness (more than 20 taxa) were concentrated along the southern slope of the Laurentian Channel (Figure 15). Also important were areas off of Gaspé near Chaleur Bay and central Prince Edward Island near Cape Breton. A large area of low richness (fewer than 13 to 16 taxa) was seen on the plateau to the south and west of the Îles de la Madeleine. The Southern Gulf had data gaps due to the low number of stations, mostly for the inshore areas of Chaleur Bay, the Acadian Peninsula, and Cape Breton (Figure 4B).

Seabirds

High seabird richness (generally more than 2 species in a grid cell) was observed in several small zones across the Northern Gulf (Figure 16). Important areas were located in the Strait of Belle Isle, northwestern Anticosti Island, and off St. George's Bay (NL). Other areas were found scattered in the channels and the Estuary. Low richness areas (no taxa; blue cells in Figure 16) were scattered in parts of the channels, but also nearshore, for example, in the Estuary and near Anticosti Island. The seabird layer had a smaller taxonomic range (maximum richness value of 8), and—similar to the Southern Gulf zooplankton—there were gaps in the study area (Figure 5; white cells in Figure 16).

In the Southern Gulf, high-richness areas for seabirds were notable off Gaspé, near the Acadian Peninsula (New Brunswick), and near Prince Edward Island including Northumberland Strait (Figure 17). Areas with few or no species were encountered in several areas to the northwest and southeast of the Îles de la Madeleine. Cape Breton also had very low richness, except for the northwestern point of the peninsula.

High species richness areas from integrated analysis of all layers

Combining the relative richness values from each of the group layers, areas with high taxon richness (upper 75%) were indicated for parts of the deep Laurentian Channel and several shelf areas in both the Northern and Southern Gulf (Figure 18).

In the Northern Gulf, large areas of the Laurentian Channel were indicated as high in richness, in particular along the southern slope towards Cabot Strait. Limited high-richness areas were found near St. George's Bay (NL), the Strait of Belle Isle, Mécatina Trough, Beaugé Bank, and Jacques Cartier Strait between the Mingan Archipelago and Anticosti Island. In the Estuary, highlighted areas were along the southern shore near Matane, at the head of the Laurentian Channel upstream of Rimouski, and off of the Manicouagan Peninsula on the northern shore.

In the Southern Gulf, large areas of high richness were again located along the southern slope of the Laurentian Channel. Inshore areas of high richness were located along Cape Breton and off of Prince Edward Island to the Acadian Peninsula near Chaleur Bay. Limited high-richness areas were found near the western coasts of the Îles de la Madeleine and in Northumberland Strait.

4. DISCUSSION

4.1. DIVERSITY AND DISTRIBUTION

Sampling intensity

Several sampling gaps appeared on the spatial grid for the surveyed area, with many cells having few or no stations. Bottom trawl surveys in both the NGSL and SGSL are planned to sample by depth-based strata, with the number of sampling stations in each stratum approximately proportional to the stratum area. The positions of stations were randomly chosen within each stratum before the survey, to cover 52 and 27 strata in the NGSL and SGSL, respectively. In the NGSL, the objective of successfully trawling at least two to three stations in all strata was seldom met during a survey year. For example, stratum 840 in the Strait of Belle Isle was poorly represented, with only 8 successfully sampled stations for 3 of the 7 survey years (2006, 2008, 2012). This area is of potential interest for high biodiversity because of the presence of water masses from the north and shallow and narrow landforms with rocky bottoms. The rugged bathymetry makes it difficult to find suitable bottom trawl sites. Furthermore, because it is the northernmost area, it was not always covered each year since the priority is to adequately sample commercial species from areas within the Gulf. As a result, while of interest for northwest Atlantic biodiversity, this stratum has been excluded in some stock assessments and other analyses pertaining to the Gulf of St. Lawrence. Other shallow areas with gaps occurred around Anticosti Island and near the North Shore; however, samples from the seven years of surveys were available to interpolate empty cells. In some cases, gaps on the grid may have resulted from the shapes of the strata. Shelves, slopes, and channel bottoms are covered by stations dispersed over long distances linearly along the strata, while the data interpolation was performed by nearest-neighbour grid cells. The large areas of channel bottoms in the Northern Gulf and the Magdalen Shallows in the Southern Gulf could be considered relatively uniform habitats and thus may host species with similar habitat needs across their territories. Some of these distributional gaps could be addressed by extending the study period or by examining other surveys in the two regions, including the snow crab surveys and sentinel fisheries.

Taxon accumulation curves

The taxon accumulation curves indicated that the bottom trawl surveys had sufficient sampling of the retained demersal fishes and benthic invertebrate taxa in each of the two regions. To represent the majority of taxa at the regional level, at least 20 stations might be considered for the fish and 50 stations for the invertebrates. The adequacy of sampling at the cell level was not evaluated, although the 100 km^2 spatial grid contained cells with up to 12 stations (up to 9 trawl stations by cell; results not shown) from the 7 years of surveys. In a study of demersal fishes in the North Sea, 20 stations per survey fishing square was deemed adequate to record the taxa in a group (Greenstreet and Piet 2008). Future analyses could examine the taxa sampled at intermediate spatial levels (geography or community) within each region (Greenstreet and Piet 2008, Johannesen et al. 2012). A recent example was the subregions (Estuary, northwest Gulf, northeast Gulf, Southern Gulf) used to examine trends in demersal fish stocks in Bourassa et al. (2013). In terms of species, some additional records of fish may occur if incidental strays of nearshore and oceanic species captured in the survey area are included. For invertebrates, more taxa will be recorded given additional effort at identifying to lower levels, in particular sponges (Porifera) in the northern region, shrimps in the southern region, and Cnidaria (e.g., sea anemones, sea pens) in both regions.

The zooplankton curves did not attain an asymptote as was seen with the fish and benthic invertebrate taxa, and thus more samples would reveal additional taxa. The zooplankton group had only a fraction of the number of samples compared to the trawl samples: 128 stations for NGSL and 33 for SGSL over 2 years, compared to >1000 trawl stations over 7 years in both regions. In addition, while the zooplankton sampling followed a standardized protocol, the identification effort varied between the two regions and in both years. Additional review is required to consolidate these differences, by merging to genus or confirming to species. This would have a minor impact on the number of total zooplankton taxa (decrease by about 5–10, or less than 10%) from the available samples.

Relative to the other groups, seabird taxa accumulated very slowly, with at least 500 km of observations needed to reveal approximately half of the available taxa. Increased efforts may be expected to reveal the occasional rare or unusual species (extralimital), as suggested from the nearly flat curve after 2000 km of transects.

Distributions

Demersal fish

Several of the high-diversity areas identified in this study have been previously cited as important areas for demersal fish in both regions (Savenkoff et al. 2007). In the Northern Gulf, important areas were located in the Estuary, in Esquiman Channel, off the coast of West Newfoundland, at the head of Anticosti Channel, and off northwest Anticosti Island, similar to what was observed by Castonguay and Valois (2007). However, our study also found differences, with high taxon richness indicated along the North Shore from the Mingan Archipelago to the Strait of Belle Isle and relatively low richness in the Laurentian Channel and at Cabot Strait; these observations were opposite the trends seen in the Castonguay and Valois (2007) study, which used catch data from 2000–2005. The change to a Campelen trawl in 2004 resulted in captures of small, non-commercial demersal fishes that were previously rare or not seen on the northern survey. Part of the difference in richness is due the increased effort and skill at identifying smaller taxa on the surveys (Benoît 2006, Bourdages et al. 2010). A later study using data from Campelen trawl captures (2004-2008) also indicated the importance of the North Shore for smaller fish species diversity (Chouinard et al. 2011). Also, Cabot Strait is a winter refuge for many demersal species (Castonguay and Valois 2007), and this seasonal feature was not accounted for in our present study.

In an earlier study of the Southern Gulf, catch data for 2000–2005 revealed similar areas of high demersal fish richness that were located on deep slopes off of Gaspé and along the Laurentian Channel, and also inshore in Chaleur Bay and parts of the coast of Cape Breton (Swain and Benoît 2007). Several areas on the Magdalen Shallows between Prince Edward Island and the Îles de la Madeleine were also noted as being high in richness in this analysis but not in the previous study.

Benthic invertebrates

A catalogue of marine invertebrates (benthic and pelagic) is available for the Gulf of St. Lawrence (Brunel et al. 1998); it includes records of 1855 taxa, which is several times greater than what was obtained on the trawl surveys. However, many taxa in the catalogue were obtained from areas not covered by the regional surveys, such as rocky bottom and intertidal zones. Other invertebrates were not adequately sampled by bottom trawl, in particular the smaller (< 2 cm) taxa found near or in the bottom sediment, which are better sampled using different boxcores, grabs, dredges, and visual census techniques, as was seen in a comparative study in the Estuary (Provencher and Nozères 2011, see also Archambault et al. 2010). Furthermore, many of the benthic taxa require considerable effort to identify to the species or even family level, which was not always possible every year and depended on personnel and special requests. As a result, only a limited fraction of smaller taxa such as polychaete worm and amphipod crustacean were recorded in trawl captures. Larger organisms, particularly molluscs, echinoderms, and decapod crustaceans, were relatively well represented. For shrimps in the Northern Gulf and echinoderms in both regions, most of the documented species in the study area were recorded in captures. Exceptions were seen with nearshore shrimps and crabs (i.e., *Crangon septemspinosa, Cancer irroratus)*, and a deep-sea decapod, the mud lobster (*Calocaris templemani*). While the latter is common in the Estuary (Gagnon et al. 2013), it is a burrowing species and not well sampled by the trawl.

Despite the known taxonomic gaps, the distributions of Northern Gulf benthic invertebrates were generally similar to those reported in an earlier study that examined data from several types of surveys (Chabot et al. 2007), with high richness observed on the North Shore and west coast of Newfoundland. Other studies examined biomasses of species assemblages with environmental conditions, with the highest species richness found to correlate with shallow water (near 100 m), high dissolved oxygen, and strong bottom currents (Lévesque 2009, Moritz et al. 2013). These conditions are found north of Anticosti Island, along the west coast of Newfoundland, and in the Strait of Belle Isle, where strong circulation and mixing processes occur in addition to high habitat heterogeneity and rocky substrates on shallow shelf areas. The current study differs from the ones cited above by suggesting some areas of higher species richness were also found in the channels, for example, in the estuary and parts of the Laurentian Channel. These deep areas have a number of sea pen and sea anemone species that were only recorded at the class level in the earlier studies that used data from 2006-2009.

In the Southern Gulf, the Magdalen Shallows displayed areas with a mix of high and low benthic richness in agreement with the important areas identified in the "benthic invertebrates" layer by Chabot et al. (2007). Despite the generally uniform bottom habitat of the Shallows, this area has a diverse hydrological regime, with both cold and warm bottom waters (Galbraith et al. 2013) that may in turn structure different benthic communities. The survey also covers strata near the coasts and into the deep channel, which contained different benthic communities that also received varying efforts at identification, similar to the northern surveys (e.g., deep-sea anemones and soft corals). Taxon groups that were well sampled, such as crabs and bivalve molluscs, could be analyzed individually for their distribution patterns in the southern and northern regions.

Pelagics

Pelagic taxa were a special group because they may have been incidental captures with the bottom trawl, making their distribution results more difficult to assess. In addition, several taxa are highly motile and may be infrequent or seasonal visitors compared to resident demersal fishes and benthic macroinvertebrates. The deep Laurentian Channel was the area of highest richness in the Northern Gulf, as may be expected, with species occupying different niches within the water column, e.g., capelan and herring near the surface, barracudina and softpout below 200 m. Higher taxonomic richness would have been observed for cells near Cabot Strait if rare captures of deepwater shrimps entering from the Atlantic Ocean had been included (Chabot et al. 2007, Savard and Nozeres 2013). Increased richness might also have been observed in some grid cells if macrozooplankton (e.g., amphipods) and the pelagic juveniles of some fish species (e.g., threebeard rockling *Gaidropsarus* spp.) had been included. A difference between the pelagic maps for the two regions was the low richness quartile (0–3 taxa) nearshore on the west coast of Newfoundland while high richness (3–7 taxa) was observed nearshore in a number of areas in the Southern Gulf. The results of these maps were in part due to distribution of taxa into quartiles, with a larger range of taxa used in Northern Gulf (0–9 vs 0–7).

Except for northwest Cape Breton, all areas of high pelagic richness identified in this study have been previously cited as important areas for pelagic fish in the SGSL (Savenkoff et al. 2007, McQuinn et al. 2012). In the NGSL, high richness areas for pelagic taxa were found throughout the Laurentian Channel, and into other deep areas (Anticosti and Esquiman channels). In a broader study of small pelagic fishes from several surveys, McQuinn et al. (2012) proposed the southern slopes of the Laurentian Channel as an important area, along with the Esquiman and Anticosti channels, but also into the shallower Strait of Belle Isle. Part of the differences with the present study may be due to the inclusion here of deepwater invertebrate taxa in the pelagic group layer.

Zooplankton

The zooplankton surveys sampled across a range of classes, from small mesozooplanktonic (<1 mm) copepods (e.g., *Acartia, Oithona*) to larger mesozooplankton (*Calanus*) and macrozooplankton (krill, mysids, amphipods, fish larvae, and jellies). The smaller and larger size classes, in particular juvenile and adult krill, may be underestimated in samples; however, the use of presence-only data here may have sufficed to reveal the diversity of the zooplankton communities.

The zooplankton taxon distributions generally followed those of the pelagic fishes, with high richness in the Laurentian Channel. In the Southern Gulf, areas with high richness were also identified in the western half of Magdalen Shallows and Cape Breton, and in the Gaspé Current, along the northern shore of the Gaspé Peninsula. Hydrodynamic features of water currents and temperature, along with the influence of coastlines and water column vertical structure, may be factors shaping the distribution of taxa at the scale of the spatial grid (Irigoien et al. 2011). On a larger scale, the repartition of richness could be related to physical and oceanographic properties of the Gulf. A study of global patterns of biodiversity showed that different spatial patterns were found among groups of coastal and oceanic species (Tittensor et al. 2010). These groups showed significantly higher richness at locations with steep gradients of sea-surface temperature, a condition that often occurs in the Laurentian Channel, especially in the Estuary and near Cabot Strait (Galbraith et al. 2013).

Seabirds

Seabird distribution resembled that of pelagic taxa in the Southern Gulf, with more taxa observed around Prince Edward Island, the Acadian Peninsula, and Cape Breton. For the Northern Gulf, higher richness was observed at some, but not all, areas of the North Shore and the Laurentian Channel. Lower richness was seen north of central Anticosti Island, similar to the result for zooplankton and pelagic taxa.

While the Northern Gulf covers a variety of depths from channels to shelves, the Southern Gulf is somewhat more uniform, dominated by the Magadalen Shallows, over which the seabirds along with the demersal fish, pelagic, and benthic groups appeared over similar areas and layers. The relatively limited depth of the Shallows may lead to increased interactions between all of the biological groups across the same areas.

4.2. LIMITATIONS AND RECOMMENDATIONS

This study produced a spatial model of high biodiversity areas in the St. Lawrence based on taxon richness in the Northern and Southern Gulf regions. The resulting maps should be viewed as an information tool regarding the presence and distribution of taxa in the regions. The approach taken here was intended to assist with comparisons, for example, by displaying richness in quartiles for the different groups. However, areas with relatively high richness values may correspond to concentrations of several species with extensive distributions and thus mask species with a restricted distribution. Zooplankton and benthic invertebrates had high frequencies of the most common species, while rare species may have been missed or not identified. Dynamic communities like zooplankton, pelagics (fishes, squid, and large jellies), and seabirds may also present different results depending on scale and period. For example, warm water from the Atlantic Ocean has been observed in recent years (2011–2012), which has been accompanied by more frequent or new capture records of southern pelagic fishes and deepwater shrimps.

Despite the wide areal coverage, the Gulf surveys had data gaps near areas of special biodiversity interest like Mécatina Trough, the lower Strait of Belle Isle, and American Bank, which were all zones with shallow rocky bottoms not suitable for trawling. Assessing biodiversity at different locations outside the survey areas (Figure 2) may bring attention to other sites of high taxon richness in the Gulf.

The bottom trawl gear was a limitation for sampling fish and macroinvertebrates, with many species including amphipods and polychaetes being too small or fragile to be sampled by the trawl net mesh, and thus their absence or rare occurrence in captures. Another bias concerns the variable taxonomic resolution of identified invertebrates. Regional identification guides for cnidarians, echinoderms, and molluscs could be made available so that species could be identified with less effort and more certainty during surveys. Guides to help with fish identification have already been produced in both regions (Daigle et al. 2006, Nozères et al. 2010).

For the invertebrates, the current study has shown the need to further validate the records from 2006-2010, with future work still needed for precise identifications, but also to verify the accuracy of presence at sites. As one example, species such as the sea potato, sea pens, and brittle stars are prone to being enmeshed in the net, particularly after a large capture, with smaller amounts then contaminating the records at subsequent stations. This becomes a concern if consecutive stations are very different in habitat, as when going from deep to shallow water, and vice versa. As many studies work with count and biomass values, the limited contamination between stations may be filtered out during data preparation for analyses, and caution may be only necessary for studies relying on presence data to habitat maps of captured taxa. Despite concerns with some records in the benthic invertebrate datasets, their group spatial patterns appear to be similar to that of the demersal fish groups, for which the capture data are reliable and consistent.

Comparisons with species checklists may be useful to assess coverage from survey samples. Nearly half of the 126 fish taxa in the Gulf of St. Lawrence Checklist posted on CaRMS (Miller 2013) were recorded on the surveys, although this list includes nearshore and estuarine species as well as historically present or rare taxa. Thus, the demersal taxon curves from the regional surveys may be reasonable. The invertebrates of the checklist number nearly 1000 taxa, with only about a quarter recorded on the surveys from the benthic, pelagic, and zooplankton groups. Thus the taxon accumulation curves for benthic organisms and zooplankton are likely insufficient, with the asymptote of the benthic curve reflecting the general identification of merged taxa.

Among the biological groups used here, pelagic taxa and seabirds were special cases. Several of the pelagic species were seasonal or stray, with their presence more likely to depend on currents and climatic conditions between survey years than was the case with demersal fish. Other pelagic species grouped here are traditionally placed in the demersal or benthic groups although they may be equally or better sampled using pelagic or mid-water trawls instead of bottom trawl gear. For seabirds, a fairly large effort was expended in transects to observe a relatively small number of species. However, the information was obtained using the platform of opportunity presented by the surveys for other species, and thus data of some value may have been gathered that would not otherwise be available.

The high biodiversity areas shown here were based on overall station taxon richness on a spatial grid of the Gulf. Hotspots of taxon richness may be evaluated by subareas, for example by the occurrence of species assemblages in differing habitats (Chouinard and Dutil 2011, Moritz et al. 2013, Tamdrari et al. 2014). In these three studies, clusters of areas were identified using multivariate analyses that also took into account biomass or abundance of fish and invertebrate species in captures between 2004–2010. The clusters were then evaluated for taxon richness and environmental factors, including habitat types, providing an interpretation of the species groups and the physical factors involved in shaping their distribution in the Gulf. Similar approaches for biodiversity community analysis may now be conducted using the more recent and standardized datasets that were prepared during the course of this study.

5. CONCLUSIONS

This study provided an overview of the distribution of taxon richness examined across different biological layers that were sampled on annual multi-species surveys across two regions in the Gulf of St. Lawrence. A number of areas were identified as hosting potentially elevated numbers of taxa, and this information could be of use in planning future MPAs for biodiversity conservation. With the Gulf of St. Lawrence as a unit for Oceans management, efforts should be continued for the identification and standardization of databases between surveys and regions. Accompanying this taxonomic information with environmental metrics will complement the ecosystem-based approach and help to better understand patterns of biodiversity in the regions.

6. ACKNOWLEDGEMENTS

The authors wish to thank Luc Savoie for providing Southern Gulf data. We are also grateful to Laure Devine, Philippe Archambault, and Cindy Grant for their comments and review of the manuscript. This work was funded by a grant awarded to Stéphane Plourde by DFO’s Strategic Program for Ecosystem-Based Research and Advice (SPERA).

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Table 1. Summary of samples (stations or transects) by region and group layer. NGSL: Northern Gulf of St. Lawrence; SGSL: Southern Gulf of St. Lawrence.

Region	**Group layer**	**Sampling method**	**Period**	**Samples**
NGSL	Fish and invertebrates	Bottom trawl	2006–2012	1251
	Zooplankton	Vertical net	2006–2007	128
	Seabirds	At-sea observers	2012–2013	609*
SGSL	Fish and invertebrates	Bottom trawl	2006–2012	1131
	Zooplankton	Vertical net	2006–2007	33
	Seabirds	At-sea observers	2012–2013	350*

* = spatial grid cells containing a transect

Table 2. Summary of taxa by group, region, and sample. Total: all taxa; retain: taxa retained for analyses; $\bar{x}$: mean number of taxa per sample; *min* and *max*: minimum and maximum number of taxa per sample, respectively. NGSL: Northern Gulf of St. Lawrence; SGSL: Southern Gulf of St. Lawrence.

	NGSL					**SGSL**				
Group	**Total**	**retain**	$\bar{x}$	***min***	***max***	**Total**	**retain**	$\bar{x}$	***min***	***max***
Demersal fish	67	57	*11.8*	*2*	*21*	67	52	*8.6*	*1*	*21*
Pelagic fish	35	14	*2.8*	*0*	*7*	25	17	*1.4*	*0*	*6*
Pelagic invertebrates	14	4	*1.3*	*0*	*4*	3	2	*0.7*	*0*	*2*
Benthic invertebrates	148	98	*13.4*	*0*	*38*	137	72	*13.2*	*1*	*28*
Zooplankton	148*	102	*28.6*	*16*	*45*	139*	76	*20*	*13*	*32*
Seabirds	39	39	*1.7*	*0*	*10*	36	36	*1.3*	*0*	*6*

* = all categories (morphotypes, stages)

Table 3. Northern Gulf of St. Lawrence demersal fish checklist from bottom trawl surveys in 2006–2012, with survey code, scientific name, order, family, and occurrences (number of stations). Dark shaded: uncertain taxa not used for diversity. Light shaded: incidental taxa not used for spatial distribution.

Code	Scientific name	Order	Family	Occur.
12	*Myxine glutinosa*	Myxiniformes	Myxinidae	694
15	*Petromyzon marinus*	Petromyzontiformes	Petromyzontidae	1
27	*Centroscyllium fabricii*	Squaliformes	Etmopteridae	144
90	*Amblyraja radiata*	Rajiformes	Rajidae	1005
91	*Malacoraja senta*	Rajiformes	Rajidae	818
94	*Rajella fyllae*	Rajiformes	Rajidae	8
100	*Leucoraja ocellata*	Rajiformes	Rajidae	1
102	*Bathyraja spinicauda*	Rajiformes	Arhynchobatidae	24
373	*Synaphobranchus kaupii*	Anguilliformes	Synaphobranchidae	7
430	Gadiformes	Gadiformes		1
436	Gadidae	Gadiformes	Gadidae	4
438	*Gadus morhua*	Gadiformes	Gadidae	690
439	*Gadus ogac*	Gadiformes	Gadidae	63
441	*Melanogrammus aeglefinus*	Gadiformes	Gadidae	14
442	*Microgadus tomcod*	Gadiformes	Gadidae	1
444	*Phycis chesteri*	Gadiformes	Phycidae	286
447	*Urophycis tenuis*	Gadiformes	Phycidae	451
453	*Gaidropsarus* spp.	Gadiformes	Lotidae	25
454	*Gaidropsarus ensis*	Gadiformes	Lotidae	2
455	*Gaidropsarus argentatus*	Gadiformes	Lotidae	19
461	*Enchelyopus cimbrius*	Gadiformes	Lotidae	796
478	*Nezumia bairdii*	Gadiformes	Macrouridae	683
699	*Anarhichas denticulatus*	Perciformes	Anarhichadidae	1
700	*Anarhichas lupus*	Perciformes	Anarhichadidae	264
701	*Anarhichas minor*	Perciformes	Anarhichadidae	67
702	*Anarhichas* spp.	Perciformes	Anarhichadidae	1
709	Stichaeidae	Perciformes	Stichaeidae	2
710	*Stichaeus punctatus*	Perciformes	Stichaeidae	14
711	*Eumesogrammus praecisus*	Perciformes	Stichaeidae	223
715	*Lumpenus fabricii*	Perciformes	Stichaeidae	3
716	*Lumpenus lampretaeformis*	Perciformes	Stichaeidae	272
717	*Leptoclinus maculatus*	Perciformes	Stichaeidae	417
718	*Anisarchus medius*	Perciformes	Stichaeidae	14
721	*Cryptacanthodes maculatus*	Perciformes	Cryptacanthodidae	51
725	Zoarcidae	Perciformes	Zoarcidae	2
726	*Lycodes* spp.	Perciformes	Zoarcidae	22
727	*Lycodes esmarkii*	Perciformes	Zoarcidae	32
728	*Lycodes lavalaei*	Perciformes	Zoarcidae	226
730	*Lycodes vahlii*	Perciformes	Zoarcidae	367
733	*Lycodes polaris*	Perciformes	Zoarcidae	7
734	*Lycodes terraenovae*	Perciformes	Zoarcidae	40
740	*Lycodes pallidus*	Perciformes	Zoarcidae	1
746	*Gymnelus viridis*	Perciformes	Zoarcidae	443

Code	Scientific name	Order	Family	Occur.
747	*Lycenchelys* spp.	Perciformes	Zoarcidae	4
750	*Lycenchelys paxillus*	Perciformes	Zoarcidae	18
752	*Lycenchelys verrillii*	Perciformes	Zoarcidae	79
792	*Sebastes* (*S. fasciatus, S. mentella*)	Scorpaeniformes	Sebastidae	1127
793	*Sebastes norvegicus*	Scorpaeniformes	Sebastidae	2
797	*Helicolenus dactylopterus*	Scorpaeniformes	Sebastidae	1
808	Cottidae	Scorpaeniformes	Cottidae	1
809	*Hemitripterus americanus*	Scorpaeniformes	Hemitripteridae	27
810	*Artediellus* spp.	Scorpaeniformes	Cottidae	55
811	*Artediellus atlanticus*	Scorpaeniformes	Cottidae	314
812	*Artediellus uncinatus*	Scorpaeniformes	Cottidae	161
813	*Triglops* spp.	Scorpaeniformes	Cottidae	12
814	*Triglops murrayi*	Scorpaeniformes	Cottidae	428
815	*Triglops nybelini*	Scorpaeniformes	Cottidae	3
817	*Myoxocephalus* spp.	Scorpaeniformes	Cottidae	2
818	*Myoxocephalus aenaeus*	Scorpaeniformes	Cottidae	1
819	*Myoxocephalus scorpius*	Scorpaeniformes	Cottidae	238
820	*Myoxocephalus octodecemspinosus*	Scorpaeniformes	Cottidae	3
823	*Gymnocanthus tricuspis*	Scorpaeniformes	Cottidae	257
829	*Cottunculus microps*	Scorpaeniformes	Psychrolutidae	9
830	*Icelus* spp.	Scorpaeniformes	Cottidae	19
831	*Icelus bicornis*	Scorpaeniformes	Cottidae	62
832	*Icelus spatula*	Scorpaeniformes	Cottidae	87
836	*Leptagonus decagonus*	Scorpaeniformes	Agonidae	228
837	*Aspidophoroides olrikii*	Scorpaeniformes	Agonidae	30
838	*Aspidophoroides monopterygius*	Scorpaeniformes	Agonidae	355
844	*Eumicrotremus spinosus*	Scorpaeniformes	Cyclopteridae	230
845	*Eumicrotremus spinosus variabilis*	Scorpaeniformes	Cyclopteridae	16
853	Liparidae	Scorpaeniformes	Liparidae	5
854	*Paraliparis* spp.	Scorpaeniformes	Liparidae	4
856	*Paraliparis copei*	Scorpaeniformes	Liparidae	25
857	*Liparis* spp.	Scorpaeniformes	Liparidae	1
862	*Liparis gibbus*	Scorpaeniformes	Liparidae	122
865	*Careproctus reinhardti*	Scorpaeniformes	Liparidae	72
867	*Liparis coheni*	Scorpaeniformes	Liparidae	1
874	*Paraliparis calidus*	Scorpaeniformes	Liparidae	40
889	*Hippoglossoides platessoides*	Pleuronectiformes	Pleuronectidae	1073
890	*Glyptocephalus cynoglossus*	Pleuronectiformes	Pleuronectidae	971
891	*Limanda ferruginea*	Pleuronectiformes	Pleuronectidae	25
892	*Reinhardtius hippoglossoides*	Pleuronectiformes	Pleuronectidae	985
893	*Hippoglossus hippoglossus*	Pleuronectiformes	Pleuronectidae	268
966	*Lophius americanus*	Lophiiformes	Lophiidae	45

Table 4. Northern Gulf of St. Lawrence pelagic fish checklist from bottom trawl surveys in 2006–2012, with survey code, scientific name, order, family, and number of occurrences. Dark shaded: uncertain taxa. Light shaded: incidental coastal and mesopelagic taxa not used for spatial distribution.

Code	Scientific name	Order	Family	Occur.
24	*Squalus acanthias*	Squaliformes	Squalidae	7
150	*Clupea harengus*	Clupeiformes	Clupeidae	741
152	*Alosa sapidissima*	Clupeiformes	Clupeidae	2
168	*Xenodermichthys copei*	Osmeriformes	Alepocephalidae	3
187	*Mallotus villosus*	Osmeriformes	Osmeridae	890
188	*Osmerus mordax*	Osmeriformes	Osmeridae	1
193	*Argentina silus*	Osmeriformes	Argentinidae	23
205	Gonostomatidae	Stomiiformes	Gonostomatidae	26
208	*Cyclothone microdon*	Stomiiformes	Gonostomatidae	14
214	*Maurolicus muelleri*	Stomiiformes	Sternoptychidae	1
220	Sternoptychidae	Stomiiformes	Sternoptychidae	4
222	*Polyipnus clarus*	Stomiiformes	Sternoptychidae	12
225	*Argyropelecus gigas*	Stomiiformes	Sternoptychidae	1
227	*Chauliodus sloani*	Stomiiformes	Stomiidae	5
230	*Stomias boa*	Stomiiformes	Stomiidae	5
271	Myctophiformes	Myctophiformes		1
272	Myctophidae	Myctophiformes	Myctophidae	91
273	*Notoscopelus* spp.	Myctophiformes	Myctophidae	2
278	*Neoscopelus macrolepidotus*	Myctophiformes	Neoscopelidae	2
285	*Lampadena speculigera*	Myctophiformes	Myctophidae	3
320	*Arctozenus risso*	Aulopiformes	Paralepididae	673
368	*Nemichthys scolopaceus*	Anguilliformes	Nemichthyidae	6
369	*Serrivomer beanii*	Anguilliformes	Serrivomeridae	3
398	*Scomberesox saurus*	Beloniformes	Scomberesocidae	14
426	*Gasterosteus aculeatus*	Gasterosteiformes	Gasterosteidae	52
440	*Micromesistius poutassou*	Gadiformes	Gadidae	1
443	*Pollachius virens*	Gadiformes	Gadidae	6
449	*Merluccius bilinearis*	Gadiformes	Merlucciidae	226
451	*Boreogadus saida*	Gadiformes	Gadidae	146
572	*Scomber scombrus*	Perciformes	Scombridae	56
696	*Ammodytes* spp.*	Perciformes	Ammodytidae	68
745	*Melanostigma atlanticum*	Perciformes	Zoarcidae	444
849	*Cyclopterus lumpus*	Scorpaeniformes	Cyclopteridae	190
982	*Cryptopsaras couesii*	Lophiiformes	Ceratiidae	3

Ammodytes* spp. includes records for *A. americanus* (695**) at 7 stations and *A. dubius* (**694**) at 1 station.

Table 5. Northern Gulf of St. Lawrence benthic invertebrates from bottom trawl surveys in 2006–2012 with classification, survey code, scientific name, and comments on taxa. Shaded: incidental or rare taxa not used for spatial distribution.

Classification	Code	Scientific name	Comments
Phylum PORIFERA	**1101**	Porifera	includes *Stylocordyla borealis*
Phylum BRYOZOA	**2670**	Bryozoa	*Alcyonidium* spp., *Securiflustra securifrons*
Phylum BRACHIOPODA			
Class Rhynchonellata			
Order Rhynchonellida			
Family Hemithirididae	**3090**	*Hemithiris psittacea*	
Order Terebratulida			
Family Cancellothyrididae	**3101**	*Terebratulina septentrionalis*	
Phylum SIPUNCULA	**5900**	Sipuncula	*Golfingia* spp., *Phascolion* spp.
Phylum CHORDATA			
Class Ascidiacea	**8680**	Ascidiacea	*Ascidia* spp. (e.g., *A. obliqua*, *A. prunum*), *Boltenia echinata*, *Eudistoma vitreum*, *Pelonaia corrugata*
	8792	*Boltenia ovifera*	
	8797	*Halocynthia pyriformis*	
Phylum CNIDARIA			
Class Anthozoa			
Order Zoantharia	**2157**	*Epizoanthus* sp.	as *E. erdmanni*
Order Actiniaria	**2165**	Actiniaria	*Actinostola callosa*, *Stomphia coccinea*, *Bolocera tuediae*, *Urticina felina*, *Actinauge cristata*, *Hormathia nodosa*, *Stephanauge nexilis*, *Liponema multicorne*
Order Alcyonacea	**2219**	Nephtheidae	Alcyonacea, *Duva florida*, *Drifa glomerata*
	2184	*Gersemia rubiformis*	
Order Scleractinia	**2224**	*Flabellum alabastrum*	
Order Pennatulacea	**2201**	Pennatulacea	*Anthoptilum grandiflorum*, *Halipteris finmarchica*, *Pennatula aculeata*, *P. grandis*
Class Hydrozoa	**1341**	Hydrozoa	*Campanularia* sp., *Rhizocaulus verticillatus*, *Hydrallmania falcata*, *Thuiaria thuja*, *Sertularella polyzonias*, *Ptychogena lactea* *Lafoea* sp.
Phylum ARTHROPODA			
Class Malacostraca			
Order Decapoda			
Family Pandalidae	**8111**	*Pandalus borealis*	
	8112	*Pandalus montagui*	
	8113	*Atlantopandalus propinqvus*	
Family Crangonidae	**8119**	*Sclerocrangon boreas*	
	8125	*Crangon septemspinosa*	only 1 record (common inshore species)

Classification	Code	Scientific name	Comments
	8128	*Sabinea septemcarinata*	
	8129	*Sabinea sarsii*	
	8135	*Pontophilus norvegicus*	
	8138	*Argis dentata*	
Family Hippolytidae	**8075**	*Eualus fabricii*	
	8077	*Eualus macilentus*	
	8080	*Eualus gaimardii gaimardii*	
	8081	*Eualus gaimardii belcheri*	distinctive, large subspecies
	8085	*Spirontocaris spinus*	
	8086	*Spirontocaris phippsii*	
	8087	*Spirontocaris lilljeborgii*	
	8092	*Lebbeus groenlandicus*	
	8093	*Lebbeus polaris*	
	8095	*Lebbeus microceros*	
Family Paguridae	**8178**	*Pagurus* spp.	*P. pubescens, P. arcuatus*
Family Oregoniidae	**8213**	*Chionoecetes opilio*	
	8217	*Hyas araneus*	
	8218	*Hyas coarctatus*	
Family Lithodidae	**8196**	*Lithodes maja*	
Family Munidopsidae	**8164**	*Munidopsis curvirostra*	
Family Axiidae	**8173**	*Calocaris templemani*	6 records; endobenthic
Order Amphipoda			
Family Epimeriidae	**7383**	*Epimeria loricata*	
	7586	*Paramphithoe hystrix*	
Family Uristidae	**7389**	*Anonyx* spp.	
Family Eusiridae	**7195**	*Eusirus cuspidatus*	
	7211	*Rhachotropis aculeata*	
Family Maeridae	**7279**	*Maera loveni*	2 records
	7691	*Wimvadocus torelli*	4 records
Family Stegocephalidae	**7750**	*Stegocephalus inflatus*	
Family Unciolidae	**7483**	*Neohela monstrosa*	large species
Order Isopoda			
Family Aegidae	**6771**	*Aega psora*	benthopelagic fish parasites
	6791	*Syscenus infelix*	benthopelagic fish parasites
Class Maxillopoda			
Order Sessilia			
Family Balanidae	**6595**	**Balanidae**	small barnacles, likely *Balanus crenatus*
Family Archaeobalanidae	**6593**	*Chirona hameri*	large species
Order Scalpelliformes			
Family Scalpellidae	**6594**	*Arcoscalpellum michelottianum*	large species
Class Pycnogonida			
Family Nymphonidae	**5961**	*Nymphon* spp.	only genus captured over the study period
Phylum MOLLUSCA			
Class Polyplacophora	**3125**	Polyplacophora	*Tonicella marmorea., T. rubra, Amicula vestita, Leptochiton alveolus, Stenosemus exaratus*
Class Gastropoda			
Order Caenogastropoda			
Family Turritellidae	**3310**	*Tachyrhynchus erosus*	1 record

Classification	Code	Scientific name	Comments
Order Trochoidea			
Family Margaritidae	**3212**	*Margarites* spp.	*M. costalis, M. groenlandicus*
Order Neotaenioglossa			
Family Aporrhaidae	**3418**	*Arrhoges occidentalis*	common capture
Order Littorinimorpha			
Family Naticidae	**3420**	Naticidae	*Cryptonatica affinis, Euspira heros, Lunatia pallida, Polinices immaculatus*
Family Velutinidae	**3452**	Velutinidae	5 records; *Limneria undata, Velutina velutina*
	3455	*Onchidiopsis* sp.	2 records; 1 unknown species
Family Littorinidae	**3248**	*Littorina* spp.	1 record, coastal species
	3249	*Littorina littorea*	1 record, coastal species
	3445	*Lacuna* spp.	1 record, coastal species
Order Neogastropoda			
Family Muricidae	**3488**	*Boreotrophon* spp.	3 species
Family Buccinidae	**3515**	Buccinidae	unidentified whelks
	3516	*Buccinum* spp.	mostly *B. undatum, B. scalariforme*
	3519	*Beringius turtoni*	group to family Buccinidae
	3575	*Colus* spp.	*C. stimpsoni, C.pubescens*
	3564	*Volutopsius norwegicus*	group to family Buccinidae
	3565	*Neptunea* spp.	*N. decemcostata, N. despecta*
	3578	*Plicifusus kroeyeri*	group to family Buccinidae
	3583	*Aulacofusus brevicauda*	group to family Buccinidae
Order Cephalaspidea			
Family Scaphandridae	**3715**	*Scaphander punctostriatus*	common capture
Order Nudibranchia	**3850**	Nudibranchia	shallow (*Dendronotus* spp.) and deepwater (*Colga villosa, Doridoxa ingolfiana*)
Class Bivalvia			
Order Nuculida			
Family Nuculidae	**4008**	*Nucula* spp.	1 record, unconfirmed
Order Nuculanoida			
Family Nuculanidae	**4019**	*Nuculana* spp.	
Family Yoldiidae	**4025**	*Megayoldia thraciaeformis*	common capture
	4074	*Yoldia* sp.	3 records, may be same species
Order Mytiloidae			
Family Mytilidae	**4121**	*Mytilus* spp.	with *Mytilus edulis*
	4124	*Crenella faba*	1 record
	4126	*Musculus* spp.	few records; includes *M. niger, M. discors*
Order Pectinoida			
Family Pectinidae	**4167**	*Chlamys islandica*	
Family Propeamussiidae	**4191**	*Similipecten greenlandicus*	includes *Delectopecten, Placopecten*
Family Anomiidae	**4219**	*Anomia* sp.	fixed on rocks, likely *A. simplex*
Order Carditoida			
Family Astartidae	**4227**	*Astarte* spp.	*A. undata, A. borealis, A. elliptica, A. subaequilatera*
Family Carditidae	**4268**	*Cyclocardia borealis*	2 records
Order Veneroida			
Family Cardiidae	**4351**	*Ciliatocardium ciliatum*	common capture
	4352	*Serripes groenlandicus*	few records
Family Mesodesmatidae	**4383**	*Mesodesma* sp.	coastal species, likely debris of *M. arctatum*
Family Tellinidae	**4393**	*Macoma* sp.	likely *Macoma calcarea* (large species)

Classification	Code	Scientific name	Comments
Order Anomalodesmata			
Family Cuspidariidae	**4525**	*Cuspidaria* sp.	likely *C. glacialis*
Order Myoida			
Family Hiatellidae	**4435**	Hiatellidae	*Hiatella arctica, Panomya norvegica*
Family Myidae	**4428**	*Mya truncata*	1 record
Family Pholadidae	**4451**	*Xylophaga atlantica*	2 records; as *Teredo navalis* **(4498)**
Family Arcidae	**4102**	*Bathyarca* sp.	2 records; likely *B. glacialis*
Class Cephalopoda			
Order Octopoda			
Family Octopodidae	**4904**	*Bathypolypus bairdii*	often misreported as *B. arcticus*
Order Sepiida			
Family Sepiolidae	**4557**	*Rossia* spp.	*R. megaptera, R. palpebrosa*
Phylum ANNELIDA			
Class Polychaeta	**4950**	Polychaeta	
Order Phyllodocida			
Family Aphroditidae	**5002**	*Aphroditella hastata*	sea mouse (large, robust species)
Phylum ECHINODERMATA			
Class Asteroidea			
Order Valvatida			
Family Poraniidae	**8435**	*Poraniomorpha* spp.	2 or more species, includes *P. hispida*
Family Solasteridae	**8447**	*Crossaster papposus*	
	8445	*Solaster endeca*	
Family Goniasteridae	**8429**	*Ceramaster granularis*	
	8431	*Hippasteria phrygiana*	
Order Forcipulatida			
Family Asteriidae	**8495**	Asteriidae	listed as *Asterias* sp. **(8396)**
	8510	*Leptasterias* spp.	includes *Leptasterias polaris* **(8453)**
Order Paxillosida			
Family Ctenodiscidae	**8407**	*Ctenodiscus crispatus*	
Family Pseudarchasteridae	**8433**	*Pseudarchaster parelii*	
Family Astropectinidae	**8520**	*Psilaster andromeda*	
	8521	*Leptychaster arcticus*	few records; needs review
Order Velatida			
Family Pterasteridae	**8408**	*Diplopteraster multipes*	
	8409	*Pteraster* spp.	*P. militaris, P. pulvillus, P. obscurus*
Order Spinulosida			
Family Echinasteridae	**8483**	*Henricia* spp.	2 more species
Class Ophiuroidea	**8530**	Ophiuroidea	several species in Order Ophiurida
Order Euryalida			
Family Gorgonocephalidae	**8540**	*Gorgonocephalus* spp.	*G. arcticus, G. eucnemis*
Class Echinoidea			
Order Echinoida			
Family Strongylocentrotidae	**8363**	Strongylocentrotus spp.	*S. droebachiensis, S. pallidus*
Order Clypeasteroida			
Family Echinarachniidae	**8373**	*Echinarachnius parma*	
Order Spatangoida			
Family Schizasteridae	**8378**	*Brisaster fragilis*	

Classification	Code	Scientific name	Comments
Class Crinoidea	**8261**	Crinoidea	*Heliometra glacialis*
Class Holothuroidea			
Order Dendrochirotida			
Family Psolidae	**8294**	*Psolus phantapus*	
	8295	*Psolus fabricii*	few records
Family Cucumariidae	**8312**	*Cucumaria frondosa*	
Order Molpadiida			
Family Molpadiidae	**8322**	*Molpadia oolitica*	listed as *Molpadia* sp.

Table 6. Northern Gulf of St. Lawrence pelagic invertebrates (excluding zooplankton) from bottom trawl surveys in 2006–2012 with classification, survey code, scientific name, and comments on taxa. Dark shaded: regrouped taxa. Light shaded: mesopelagic taxa not used for spatial distribution.

Classification	Code	Scientific name	Comments
Phylum CNIDARIA			
Class Scyphozoa	**2040**	Scyphozoa	large jellyfishes, including *Aurelia aurita*
	2080	*Cyanea capillata*	7 records; lion's mane jelly
	2095	*Atolla* sp.	1 record; deepwater jelly, as *A. wyvillei*
	2096	*Periphylla periphylla*	1 record; deepwater jelly
Phylum MOLLUSCA			
Class Cephalopoda			
Order Oegopsida	**4753**	*Illex illecebrosus*	northern shortfin squid
Order Octopoda	**4846**	Octopoda	2 records; *Stauroteuthis syrtenis*
Phylum ARTHROPODA			
Order Decapoda			
Family Aristeidae	**8024**	*Aristaeopsis edwardsiana*	1 record from 2011; large species
Family Solenoceridae	**8028**	*Hymenopenaeus debilis*	1 record from 2011; southern species
Family Sergestidae	**8033**	*Eusergestes arcticus*	42 records, 25 from 2011-2012
	8035	*Sergia robusta*	6 records from 2011-2012
Family Acanthephyridae	**8040**	*Acanthephyra pelagica*	4 records, 3 from 2011-2012
Family Pasiphaeidae	**8056**	*Pasiphaea tarda*	4 records, 3 from 2011-2012; large species
	8057	*Pasiphaea multidentata*	682 records
Family Pandalidae	**8114**	*Plesionika martia*	2 records from 2011-2012; southern species

Table 7. Southern Gulf of St. Lawrence demersal fishes in 2006–2012 with survey code, scientific name, order, family, and occurrences (number of stations). Dark shaded: uncertain taxa. Light shaded: incidental taxa not used for spatial distribution.

Code	Scientific name	Order	Family	Occur.
10	*Gadus morhua*	Gadiformes	Gadidae	896
11	*Melanogrammus aeglefinus*	Gadiformes	Gadidae	3
12	*Urophycis tenuis*	Gadiformes	Phycidae	241
17	*Microgadus tomcod*	Gadiformes	Gadidae	2
23	*Sebastes* spp.	Scorpaeniformes	Sebastidae	274
30	*Hippoglossus hippoglossus*	Pleuronectiformes	Pleuronectidae	164
31	*Reinhardtius hippoglossoides*	Pleuronectiformes	Pleuronectidae	285
40	*Hippoglossoides platessoides*	Pleuronectiformes	Pleuronectidae	1006
41	*Glyptocephalus cynoglossus*	Pleuronectiformes	Pleuronectidae	233
42	*Limanda ferruginea*	Pleuronectiformes	Pleuronectidae	579
43	*Pseudopleuronectes americanus*	Pleuronectiformes	Pleuronectidae	320
50	*Anarhichas lupus*	Perciformes	Anarhichadidae	36
51	*Anarhichas minor*	Perciformes	Anarhichadidae	5
52	*Anarhichas denticulatus*	Perciformes	Anarhichadidae	3
112	*Phycis chesteri*	Gadiformes	Phycidae	40
114	*Enchelyopus cimbrius*	Gadiformes	Lotidae	140
115	*Gaidropsarus ensis*	Gadiformes	Lotidae	3
118	*Gadus ogac*	Gadiformes	Gadidae	180
122	*Tautogolabrus adspersus*	Perciformes	Labridae	69
143	*Scophthalmus aquosus*	Pleuronectiformes	Scophthalmidae	61
201	*Amblyraja radiata*	Rajiformes	Rajidae	275
202	*Malacoraja senta*	Rajiformes	Rajidae	106
203	*Leucoraja erinacea*	Rajiformes	Rajidae	1
204	*Leucoraja ocellata*	Rajiformes	Rajidae	39
205	*Bathyraja spinicauda*	Rajiformes	Arhynchobatidae	1
221	*Centroscyllium fabricii*	Squaliformes	Etmopteridae	8
240	*Petromyzon marinus*	Petromyzontiformes	Petromyzontidae	1
241	*Myxine glutinosa*	Myxiniformes	Myxinidae	96
300	*Myoxocephalus octodecemspinosus*	Scorpaeniformes	Cottidae	294
301	*Myoxocephalus scorpius*	Scorpaeniformes	Cottidae	240
302	*Gymnocanthus tricuspis*	Scorpaeniformes	Cottidae	320
303	*Myoxocephalus aenaeus*	Scorpaeniformes	Cottidae	6
304	*Triglops murrayi*	Scorpaeniformes	Cottidae	358
306	*Artediellus uncinatus*	Scorpaeniformes	Cottidae	146
307	*Cottunculus microps*	Scorpaeniformes	Psychrolutidae	1
313	*Icelus bicornis*	Scorpaeniformes	Cottidae	4
314	*Icelus spatula*	Scorpaeniformes	Cottidae	225
320	*Hemitripterus americanus*	Scorpaeniformes	Hemitripteridae	152
340	*Aspidophoroides monopterygius*	Scorpaeniformes	Agonidae	424
341	*Aspidophoroides olrikii*	Scorpaeniformes	Agonidae	166
350	*Leptagonus decagonus*	Scorpaeniformes	Agonidae	217
351	Agonidae	Scorpaeniformes	Agonidae	1
400	*Lophius americanus*	Lophiiformes	Lophiidae	9
410	*Nezumia bairdii*	Gadiformes	Macrouridae	83

Code	Scientific name	Order	Family	Occur.
440	Ophichthidae	Anguilliformes	Ophichthidae	1
500	*Liparis* spp.	Scorpaeniformes	Liparidae	6
502	*Eumicrotremus spinosus*	Scorpaeniformes	Cyclopteridae	143
504	*Liparis liparis*	Scorpaeniformes	Liparidae	1
505	*Liparis fabricii*	Scorpaeniformes	Liparidae	11
512	*Liparis gibbus*	Scorpaeniformes	Liparidae	266
520	*Careproctus reinhardti*	Scorpaeniformes	Liparidae	13
600	*Anguilla rostrata*	Anguilliformes	Anguillidae	1
603	*Lycenchelys verrillii*	Perciformes	Zoarcidae	2
616	*Gymnelus viridis*	Perciformes	Zoarcidae	62
619	*Lycodes terraenovae*	Perciformes	Zoarcidae	2
620	*Lycodes lavalaei*	Perciformes	Zoarcidae	300
621	*Pholis gunnellus*	Perciformes	Pholidae	3
622	*Lumpenus lampretaeformis*	Perciformes	Stichaeidae	130
623	*Leptoclinus maculatus*	Perciformes	Stichaeidae	511
624	*Stichaeus punctatus*	Perciformes	Stichaeidae	5
625	*Ulvaria subbifurcata*	Perciformes	Stichaeidae	11
626	*Eumesogrammus praecisus*	Perciformes	Stichaeidae	187
628	*Lycodes polaris*	Perciformes	Zoarcidae	13
630	*Cryptacanthodes maculatus*	Perciformes	Cryptacanthodidae	38
631	*Lumpenus fabricii*	Perciformes	Stichaeidae	6
632	*Anisarchus medius*	Perciformes	Stichaeidae	162
640	*Zoarces americanus*	Perciformes	Zoarcidae	44
642	*Lycodes* spp.	Perciformes	Zoarcidae	1
643	*Lycodes esmarki*	Perciformes	Zoarcidae	1
647	*Lycodes vahlii*	Perciformes	Zoarcidae	99
868	*Paraliparis calidus*	Scorpaeniformes	Liparidae	1
880	*Artediellus atlanticus*	Scorpaeniformes	Cottidae	245

Table 8. Southern Gulf of St. Lawrence pelagic fishes in 2006–2012 with survey code, scientific name, order, family, and occurrences (number of stations). Dark shaded: uncertain taxa not used for diversity. Light shaded: incidental taxa not used for spatial distribution.

Code	Scientific name	Order	Family	Occur.
14	*Merluccius bilinearis*	Gadiformes	Merlucciidae	29
16	*Pollachius virens*	Gadiformes	Gadidae	4
60	*Clupea harengus*	Clupeiformes	Clupeidae	468
61	*Alosa sapidissima*	Clupeiformes	Clupeidae	27
62	*Alosa pseudoharengus*	Clupeiformes	Clupeidae	166
63	*Osmerus mordax*	Osmeriformes	Osmeridae	175
64	*Mallotus villosus*	Osmeriformes	Osmeridae	586
65	*Salmo salar*	Salmoniformes	Salmonidae	3
70	*Scomber scombrus*	Perciformes	Scombridae	126
88	*Naucrates ductor*	Perciformes	Carangidae	1
110	*Boreogadus saida*	Gadiformes	Gadidae	10
138	*Lampadena speculigera*	Myctophiformes	Myctophidae	3
150	Myctophidae	Myctophiformes	Myctophidae	1
154	*Cyclothone microdon*	Stomiiformes	Gonostomatidae	5
159	*Stomias boa ferox*	Stomiiformes	Stomiidae	2
169	*Chauliodus sloani*	Stomiiformes	Stomiidae	2
220	*Squalus acanthias*	Squaliformes	Squalidae	9
230	*Lamna nasus*	Lamniformes	Lamnidae	1
361	*Gasterosteus aculeatus*	Gasterosteiformes	Gasterosteidae	116
364	*Gasterosteus wheatlandi*	Gasterosteiformes	Gasterosteidae	2
501	*Cyclopterus lumpus*	Scorpaeniformes	Cyclopteridae	55
610	*Ammodytes dubius*	Perciformes	Ammodytidae	140
646	*Melanostigma atlanticum*	Perciformes	Zoarcidae	56
701	*Peprilus triacanthus*	Perciformes	Stromateidae	14
712	*Arctozenus risso*	Aulopiformes	Paralepididae	94
720	*Scomberesox saurus*	Beloniformes	Scomberesocidae	1
770	*Menidia menidia*	Atheriniformes	Atherinopsidae	13

Table 9. Southern Gulf of St. Lawrence benthic invertebrates from surveys in 2006–2012, with classification, survey code, scientific name, and comments. Dark shaded: uncertain taxa, and taxa to be regrouped. Light shaded: incidental or rare taxa.

Classification	Code	Scientific name	Comments
Phylum PORIFERA	**8600**	Porifera	232 records
Family Polymastiidae	**8610**	*Polymastia* spp.	19 records
	8611	*Polymastia mammilaris*	23 records
	8612	*Tentorium semisuberites*	55 records
Family Suberitidae	**8613**	*Suberites ficus*	78 records
Family Acarnidae	**8614**	*Iophon* sp.	18 records
Family Mycalidae	**8616**	*Mycale lingua*	148 records
Family Desmacellidae	**8617**	*Biemna variantia*	52 records
Family Chalinidae	**8618**	*Haliclona* sp.	2 records in 2011
	8621	*Haliclona oculata*	42 records
Family Halichondriidae	**8620**	*Halichondria sitiens*	202 records
	8623	*Halichondria panicea*	81 records
Family Axinellidae	**8366**	*Phakellia* sp.	5 records in 2011
	8624	*Phakellia ventilabrum*	54 records
Phylum BRACHIOPODA	**1930**	Brachiopoda	57 records; 2 species likely
	1932	*Terebratulina* sp.	6 records; likely 1 species
Phylum BRYOZOA	**1920**	Bryozoa	71 records; sessile, fixed taxa
Phylum CHORDATA			
Subphylum Tunicata	**1810**	Tunicata	230 records; use as Asidiacea
Class Thaliacea	**1845**	Thaliacea	1 salp (gelatinous zooplankter)
Class Ascidiacea	**1821**	*Ascidia* spp.	9 records
Family Pyuridae	**1823**	*Boltenia ovifera*	561 records
	1827	*Halocynthia pyriformis*	33 records
Phylum CNIDARIA	**8200**	Cnidaria	139 records; unspecified
Class Anthozoa	**8300**	Anthozoa	consider as Actinaria (**8208**)
Order Actiniaria	**8208**	Actiniaria	1 record in 2011
Family Actinostolidae	**8313**	*Stomphia coccinea*	8 records
Family Actiniidae	**8317**	*Bolocera tuediae*	3, as *Bolocera* sp.
Family Hormathiidae	**8319**	*Actinauge cristata*	1, as *A. verrillii*
	8316	*Hormathia nodosa*	2, as *Hormathia* sp.
Order Alcyonacea	**8327**	Alcyonacea	1 record; soft coral unidentified
Family Nephtheidae	**8324**	*Duva multiflora*	416 records; use as Nephtheidae
Family Primnoidae	**8322**	*Primnoa resedaeformis*	1 record
Family Isididae	**8329**	*Acanella arbuscula*	6 records at <70 m
Family Plexauridae	**8333**	*Paramuricea* sp.	2 records at <100 m
Order Pennatulacea	**8318**	Pennatulacea	as *Pennatula borealis*
Order Zoantharia	**8321**	*Epizoanthus incrustatus*	1 record in 2012
Class Hydrozoa	**8400**	Hydrozoa	48 records in 2010-2011

Classification	Code	Scientific name	Comments
Phylum ARTHROPODA			
Subphylum Crustacea			
Class Malacostraca			
Order Decapoda	**2100**	Decapoda	1009 records; shrimps, crabs
Family Pandalidae	**2212**	*Pandalus montagui*	1 record; in Decapoda
Family Crangonidae	**2414**	*Sclerocrangon boreas*	1 record; in Decapoda
Family Cancridae	**2511**	*Cancer borealis*	2 records in 2007-2008
	2513	*Cancer irroratus*	257 records
Family Oregoniidae	**2526**	*Chionoecetes opilio*	877 records
	2520	*Hyas* spp.	9 records; small specimens
	2527	*Hyas araneus*	408 records
	2521	*Hyas coarctatus*	689 records
Family Paguridae	**2560**	*Pagurus* spp.	518 records as Paguroidea
Family Nephropidae	**2550**	*Homarus americanus*	205 records
Family Lithodidae	**2523**	*Lithodes maja*	90 records; deepwater species
	2525	*Lithodes/Neolithodes*	1 record; in Decapoda
	2556	*Munida valida*	1 record; unlikely, in Decapoda
	2566	*Munidopsis curvirostra*	1 record; in Decapoda
Order Amphipoda	**2800**	Amphipoda	72 records; shallow water
Family Caprellidae	**2873**	*Aeginina longicornis*	1 record in 2010
Family Gammaridae	**2811**	Gammaridae	1 record
Family Uristidae	**2833**	*Anonyx* spp.	6 records in 2009, 2010
Order Isopoda	**2980**	Isopoda	17 records in shallow & deep
Class Maxillopoda			
Infraclass Cirripedia	**2990**	Cirripedia	7 records; unspecified barnacles
Subphylum Chelicerta			
Class Pycnogonida	**5100**	Pycnogonida	10 records
	5101	Pycnogonidae	1 record
	5102	*Pycnogonum litorale*	4 records
Phylum MOLLUSCA	**4000**	Mollusca	631 records
Class Gastropoda	**4200**	Gastropoda	37 records
Superfamily Trochoidea			
Family Trochidae	**4255**	Trochidae	8 records; use as *Margarites* spp.
Family Margaritidae	**4224**	*Margarites costalis*	15 records since 2010
(formerly Trochidae)	**4225**	*Margarites groenlandicus*	3 records since 2011
Family Calliostomatidae	**4259**	*Calliostoma occidentale*	4 records; use as *Margarites* spp.
Order Neotaenioglossa			
Family Aporrhaidae	**4230**	*Arrhoges occidentalis*	5 records as *Aporrhais* sp.
Order Littorinimorpha			
Family Naticidae	**4221**	*Euspira heros*	45 records as *Lunatia heros*
Family Littorinidae	**4250**	Littorinidae	4 records, at 40-100 m; review
Family Buccinidae	**4209**	Buccinidae	72 records
	4210	*Buccinum* spp.	282 records
	4211	*Buccinum undatum*	317 records
	4212	*Buccinum scalariforme*	2 records
	4227	*Neptunea decemcostata*	39 records
	4228	*Colus* spp.	3 records

Classification	Code	Scientific name	Comments
Order Caenogastropoda			
Family Epitoniidae	**4240**	*Boreoscala greenlandica*	2 records as *Epitonium* sp.
Order Nudibranchia	**4400**	Nudibranchia	146 records
Family Dendronotidae	**4410**	*Dendronotus* spp.	20 records in 2007, 2010
Class Bivalvia	**4300**	Bivalvia	373 records
Order Mytiloida			
Family Mytilidae	**4330**	Mytilidae	33 records
	4331	*Mytilus edulis*	3 records
	4332	*Modiolus modiolus*	5 records
	4334	*Musculus niger*	10 records
Order Pectinoida			
Family Pectinidae	**4320**	Pectinidae	2 records (2006-2007)
	4321	*Placopecten magellanicus*	57 records
	4322	*Chlamys islandica*	120 records
Order Carditoida			
Family Astartidae	**4316**	*Astarte* spp.	20 records
	4307	*Astarte undata*	1 record
Family Carditidae	**4344**	*Cyclocardia borealis*	1 record as *Venericardia b.*
Order Veneroida			
Family Arcticidae	**4304**	*Arctica islandica*	42 records
Family Cardiidae	**4340**	Cardiidae	26 records; unspecified cockles
	4342	*Ciliatocardium ciliatum*	55 records
	4343	*Serripes groenlandicus*	2 records
Family Cardiidae	**4345**	*Parvicardium pinnulatum*	1 record, as *Cerastoderma p.*
Family Tellinidae	**4303**	*Tellina* sp.	1 record; likely *Macoma calcarea*
Family Mactridae	**4317**	*Spisula solidissima*	9 records
	4355	*Mactromeris polynyma*	3 records
Family Veneridae	**4323**	*Mercenaria mercenaria*	3 records
Order Anomalodesmata			
Family Cuspidariidae	**4306**	*Cuspidaria glacialis*	2 records
Order Nuculanoida			
Family Nuculanidae	**4351**	*Nuculana* spp.	9 records
Family Yoldiidae	**4354**	*Yoldia* sp.	1 record
(Cryptodonta)	**4310**	(invalid taxon)	30 records; may refer to Myoida
Order Myoida			
Family Hiatellidae	**4312**	*Cyrtodaria siliqua*	22 records
	4319	*Hiatella arctica*	6 records
Family Myidae	**4318**	*Mya arenaria*	9 records; likely *Macoma*
Class Cephalopoda			
Order Octopoda	**4521**	Octopoda	42 records; likely *B. bairdii*
	4529	Octopodidae	1 record in 2009
	4524	*Bathypolypus bairdii*	listed as *Bathypolypus arcticus*
Order Sepiida	**4522**	*Semirossia tenera*	53 records; use as *Rossia* spp.
	4525	*Rossia palpebrosa*	1 record; use as *Rossia* spp.
	4526	*Rossia megaptera*	1 record; use as *Rossia* spp.
Class Polyplacophora	**4700**	Polyplacophora	20 records; various chitons

Classification	Code	Scientific name	Comments
Phylum NEMATODA	**7000**	*Nematoda*	7 records; parasites, round worms
Phylum PRIAPULIDA	**3451**	*Priapulus caudatus*	3 records; rare
Phylum SIPUNCULA	**3700**	*Sipunculus* spp.	1 record; uncertain
Phylum ANNELIDA	**3000**	Annelida	5 records
Class Polychaeta	**3100**	Polychaeta	443 records
Family Aphroditidae	**3200**	*Aphroditella hastata*	3 records as *Aphrodita hastata*
	3212	*Aphrodita* spp.	66 records; use as *A. hastata* **3200**
Family Polynoidae	**3500**	Polynoidae	19 records
Family Arenicolidae	**3161**	*Arenicola marina*	7 records
Family Scalibregmatidae	**3152**	*Scalibregma inflatum*	3 records
Family Capitellidae	**3133**	Capitellidae	1 record
Family Pectinariidae	**3149**	*Cistenides granulata*	1 record as *Pectinaria granulata*
Family Nereididae	**3150**	Nereididae	1 record
	3131	*Nereis pelagica*	4 records
Phylum ECHINODERMATA	**6000**	Echinodermata	1 record
Class Asteroidea	**6100**	Asteroidea	61 records; unspecified sea stars
Order Valvatida			
Family Goniasteridae	**6117**	*Hippasteria phrygiana*	129 records
Family Poraniidae	**6129**	*Poraniomorpha hispida*	3 records; may be several species
Family Solasteridae	**6120**	*Solaster* spp.	55 records in 2006; sunstars
	6121	*Solaster endeca*	320 records, purple sun star
	6123	*Crossaster papposus*	728 records as *Solaster papposus*
Order Forcipulatida			
Family Asteriidae	**6110**	*Asterias* spp.	134 records; treat as Asteriidae
	6111	*Asterias rubens*	74 records as *Asterias vulgaris*
	6113	*Leptasterias polaris*	398 records, large sea star
	6132	*Leptasterias mulleri*	1 record, 250 g
	6134	*Leptasterias tenera*	3 records; small star
Order Paxillosida			
Family Astropectinidae	**6135**	*Astropecten duplicatus*	12 records; *Psilaster andromeda* ?
Family Ctenodiscidae	**6115**	*Ctenodiscus crispatus*	214 records
Order Velatida			
Family Pterasteridae	**6125**	*Pteraster militaris*	110 records
Order Spinulosida			
Family Echinasteridae	**6119**	*Henricia sanguinolenta*	456 records
Class Ophiuroidea	**6200**	Ophiuroidea	533 records; treat as Ophiurida
Order Ophiurida	**6211**	*Ophiopholis aculeata*	1 record
	6213	*Ophiura sarsii*	1 record
Order Euryalida			
Family Gorgonocephalidae	**6300**	*Gorgonocephalus* spp.	675 records as Gorgonocephalidae
Class Echinoidea			
Order Echinoida			
Family Camarodonta	**6400**	*Strongylocentrotus* spp.	839 records; 2 species
Order Clypeasteroida			
Family Echinarachniidae	**6500**	*Echinarachnius parma*	498 records as Clypeasteroida
Order Spatangoida			
Family Schizasteridae	**6413**	*Brisaster fragilis*	44 records; deepwater only

Classification	Code	Scientific name	Comments
Class Holothuroidea	**6600**	Holothuroidea	361 records; *Cucumaria frondosa*
Order Dendrochirotida			
Family Psolidae	**6715**	*Psolus phantapus*	31 records; burrowing holothurid
	6713	*Psolus fabricii*	154 records; coastal holothurid
Order Molpadiida			deepwater burrowing holothurid
Family Molpadiidae	**6718**	*Molpadia* sp.	2 records in 2009 in shallow water
	6720	*Molpadia musculus*	2 records in 2008 in shallow water

Table 10. Southern Gulf pelagic invertebrates (excluding zooplankton) from bottom trawl surveys in 2006–2012 with classification, survey code, scientific name, and comments on taxa. Dark shaded: incidental record not used for diversity.

Classification	Code	Scientific name	Comments
PHYLUM CNIDARIA			
Class Scyphozoa	**8500**	Scyphozoa	large jellyfishes (likely *Aurelia aurita* and *Cyanea capillata*)
PHYLUM MOLLUSCS			
Class Cephalopoda			
Order Oegopsida			
Family Ommastrephidae	**4511**	*Illex illecebrosus*	286 records; shortfin squid
Order Myopsida			
Family Loliginidae	**4512**	*Doryteuthis pealeii*	1 record; longfin squid

Table 11. Zooplankton from Northern and Southern Gulf surveys (2006–2007).

Classification	Name	Region	Comments
Phylum ANNELIDA			
Class Polychaeta	Polychaeta	N S	incl. larvae
Order Phyllodocida			
Familly Tomopteridae	*Tomopteris* spp.	N	
	Tomopteris helgolandica	S	
	Tomopteris septentrionalis	S	
Phylum BRYOZOA	Bryozoa	N S	
Phylum CHAETOGNATHA	Chaetognatha	N S	
Class Sagittoidea			
Order Aphragmophora			
Familly Sagittidae	Sagittidae	S	*Sagitta* sp.
	Parasagitta spp.	S	
	Parasagitta elegans	N	
	Pseudosagitta maxima	S	
	Serratosagitta serratodentata	S	
Order Phragmophora			
Familly Eukrohniidae	*Eukrohnia hamata*	N S	
Phylum CHORDATA			
Subphylum Vertebrata	Pisces	N S	fish eggs, larvae
Subphylum TUNICATA			
Class Appendicularia	Appendicularia	N	= Larvacea
Order Copelata	*Fritillaria* spp.	N S	1 species
Familly Fritillariidae	*Fritillaria borealis*	N	
Familly Oikopleuridae	*Oikopleura* spp.	N S	
Phylum CNIDARIA	Cnidaria	N S	unspecified medusae
Class Hydrozoa			
Order Anthoathecata			
Familly Bougainvilliidae	*Nemopsis bachei*	N	hydromedusae
Family Pandeidae	*Leuckartiara* sp.	N	hydromedusae, *L. octana*
Order Leptothecata			
Familly Campanulariidae	*Obelia* spp.	S	hydromedusae
Familly Mitrocomidae	*Halopsis* spp	N	hydromedusae
	Halopsis ocellata	N	hydromedusae
Order Siphonophorae			
Family Diphyidae	*Dimophyes arctica*	N	
Order Trachymedusae			
Family Rhopalonematidae	*Aglantha digitale*	N S	
Class Scyphozoa			
Order Semaeostomeae			
Family Ulmaridae	*Aurelia* spp.	N	
Phylum CTENOPHORA	Ctenophora	N	
Class Nuda			
Order Beroida			
Family Beroidae	*Beroe* spp.	N	
	Beroe cucumis	S	

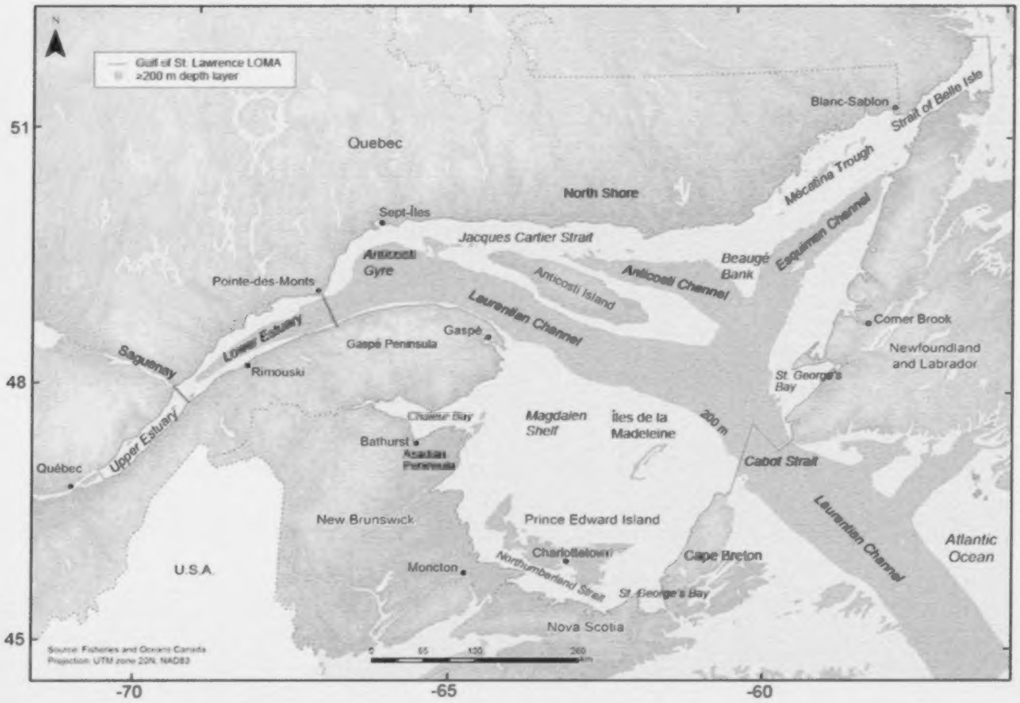
Classification	Name	Region	Comments
Class Tentaculata			
Order Cydippida			
Family Pleurobrachiidae	*Pleurobrachia pileus*	S	
Phylum ECHINODERMATA	Echinodermata	N S	larvae
Phylum MOLLUSCA			
Class Bivalvia	Bivalvia	N S	
Class Gastropoda	Gastropoda	N S	eggs
Superorder Pteropoda	Pteropoda	N	older group name
Order Gymnosomata	Gymnosomata	S	
Family Clionidae	*Clione limacina*	N	
Order Thecosomata			
Family Limacinidae	*Limacina* spp.	N S	
	Limacina helicina	N S	
Phylum ARTHROPODA			
Subphylum CRUSTACEA			
Class Branchiopoda			
Order Cladocera	Cladocera	N	
Order Diplostraca			
Family Podonidae	*Evadne* spp.	N S	
	Evadne spinifera	S	
	Podon spp.	N S	
	Podon leuckartii	S	
Class Malacostraca			
Order Amphipoda			
Family Gammaridea	Gammaridea	N	
Family Hyperiidae	*Hyperia* spp.	N	
	Hyperoche medusarum	N	= *Hyperia kroyeri*
	Themisto spp.	N S	= likely smaller individuals
	Themisto abyssorum	N S	
	Themisto compressa	N S	
	Themisto libellula	N S	
Family Scinidae	*Scina borealis*	N	
Order Cumacea	Cumacea	N	
Order Decapoda	Decapoda	N	zoea larvae
Infraorder Caridea	Caridea	N	shrimps
Familly Pandalidae	*Pandalus montagui*	S	
Familly Pasiphaeidae	*Pasiphaea* spp.	S	
	Pasiphaea multidentata	S	
	Pasiphaea tarda	S	
Infraorder Brachyura	Brachyura	N	megalopa, zoea
Familly Paguridae	*Pagurus* spp.	N	
Order Euphausiacea	Euphausiidae	N S	eggs, nauplii
	Meganyctiphanes norvegica	N S	
	Thysanoessa inermis	N	
	Thysanoessa longicaudata	N S	
	Thysanoessa raschii	N S	
Order Isopoda	Isopoda	N	

Classification	Name	Region	Comments
Order Mysida	Mysida	N S	= Mysidacea; manca larvae
Familly Mysidae	*Boreomysis arctica*	N	
	Boreomysis tridens	N	
	Erythrops spp.	N	
	Erythrops erythrophthalma	N	
	Meterythrops sp.	N	
	Mysis spp.	N	
	Mysis mixta	N	
	Pseudomma spp.	N	
Class Maxillopoda	Cirripedia	N	barnacle cypris, nauplii
Subclass Copepoda	Copepoda	N S	
Order Calanoida			
Familly Acartiidae	*Acartia* spp.	N S	
	Acartia clausi	N	= *A. hudsonica*
	Acartia hudsonica	N S	
	Acartia longiremis	N S	
Familly Aetideidae	Aetideidae	N S	
	Aetideus armatus	N S	
	Bradyidius similis	N	
	Chiridius spp.	N	
	Chiridius gracilis	N	
	Gaetanus tenuispinus	N S	= *Gaidius tenuispinus*
Familly Calanidae			
	Calanus finmarchicus	N S	
	Calanus glacialis	N S	
	Calanus hyperboreus	N S	
Familly Centropagidae	*Centropages* spp.	N S	
	Centropages hamatus	N S	
	Centropages typicus	N	
Familly Clausocalanidae	*Clausocalanus* spp.	S	
	Microcalanus spp.	N S	
	Pseudocalanus spp.	N S	
	Pseudocalanus minutus	N	
Familly Euchaetidae	*Euchaeta* spp.	S	
	Paraeuchaeta norvegica	N S	= *Euchaeta norvegica*
Familly Heterorhabdidae	*Heterorhabdus* sp.	S	
Familly Metridinidae	*Metridia* spp.	N	
	Metridia longa	N S	
	Metridia lucens	N S	
Familly Paracalanidae	*Paracalanus* spp.	N S	= *Paracalanus parvus*
Familly Phaennidae	*Xanthocalanus* spp.	N	Arctic species
Familly Pontellidae	*Anomalocera opalus*	N	= *A. patersoni*
Familly Scolecitrichidae	*Scolecithricella abyssalis*	S	southern species
	Scolecithricella minor	N S	
Familly Spinocalanidae	*Spinocalanus abyssalis*	S	southern species
Familly Temoridae	*Eurytemora* spp.	N	
	Eurytemora herdmani	N S	
	Eurytemora affinis	N	= *E. hirundoides*
	Temora longicornis	N S	
Familly Tortanidae	*Tortanus discaudatus*	S	

Classification	Name	Region		Comments
Order Cyclopoida				
Familly Oithonidae	*Oithona* spp.	N	S	
	Oithona atlantica	N	S	
	Oithona similis	N	S	
	Oithona spinirostris	N		
Order Harpacticoida			S	
Familly Ectinosomatidae	*Microsetella* spp.	N		
	Microsetella norvegica	N	S	
Order Poecilostomatoida				
Familly Oncaeidae	*Oncaea* spp.	N	S	
	Triconia borealis	N		= *Oncaea borealis*
	Triconia conifera	N	S	= *Oncaea conifera*
Class Ostracoda	Ostracoda	N		
Order Halocyprida				
Familly Halocyprididae	*Conchoecia* spp.		S	

Table 12. Seabirds observed on the Northern and Southern Gulf surveys (2012–2013).

Classification	Code	Scientific name	Region		Comments
Order Anseriformes					
Family Anatidae	**CAME**	Merginae	N	S	unknown sea duck
	MANO	*Melanitta nigra*	N	S	
	MABR	*Melanitta fusca*	N	S	
	EIDU	*Somateria mollissima*	N		
Order Charadriiformes					
Family Alcidae	**ALSP**	Alcidae	N	S	unknown alcid
	GUPP	*Alca/Uria*	N		murre or razorbill
	PEPI	*Alca torda*	N		
	MENA	*Alle alle*	N	S	
	GUMI	*Cepphus grylle*	N	S	
	MAMO	*Fratercula arctica*	N		
	GUMA	*Uria aalge*	N	S	
	GUBR	*Uria lomvia*	N		
Family Laridae	**GOSP**	Laridae	N	S	unknown gull
	MORI	*Chroicocephalus ridibundus*		S	
	GOMA	*Larus marinus*	N	S	
	GOAR	*Larus argentatus*	N	S	
	GOAC	*Larus glaucoides*		S	
	GOBR	*Larus fuscus*		S	
	GOBC	*Larus delawarensis*	N		
	MOTR	*Rissa tridactyla*	N	S	
	MOBO	*Chroicocephalus philadelphia*		S	
Family Phalaropodidae	**PHSP**	*Phalaropus* spp.	N	S	
	PHBL	*Phalaropus fulicarius*		S	
	PHBE	*Phalaropus lobatus*	N	S	
	PHWI	*Phalaropus tricolor*		S	
Family Stercorariidae	**GRLA**	*Stercorarius skua*		S	
	LASP	*Stercorarius* spp.	N	S	
	LAPA	*Stercorarius parasiticus*	N	S	
	LAPO	*Stercorarius pomarinus*	N		
Family Sternidae	**STSP**	Sternidae	N	S	unknown tern
	GUNO	*Chlidonias niger*	N		
	STAR	*Sterna paradisaea*	N	S	
	STPI	*Sterna hirundo*	N	S	
Order Gaviiformes					
Family Gaviidae	**PLCA**	*Gavia stellata*	N	S	
Order Pelecaniformes	**COSP**	*Phalacrocorax* sp.	N		
Family Phalacrocoracidae	**COAI**	*Phalacrocorax auritus*	N	S	
	GRCO	*Phalacrocorax carbo*	N	S	
Family Sulidae	**FOBA**	*Morus bassanus*	N	S	
Order Procellariiformes					
Family Hydrobatidae	**OCSP**	Hydrobatidae	N	S	unknown storm petrel
	OCWI	*Oceanites oceanicus*	N	S	
	OCCB	*Oceanodroma leucorhoa*	N	S	
Family Procellariidae	**FUBO**	*Fulmarus glacialis*	N	S	
	PUSP	*Puffinus* spp.	N		or *Calonectris* spp.
	PUMA	*Puffinus gravis*	N	S	
	PUAN	*Puffinus puffinus*	N	S	


N
Gulf of St. Lawrence LOMA
≥200 m depth layer
51
48
45
-70
-65
-60
Quebec
North Shore
Blanc-Sablon
Strait of Belle Isle
Mécatina Trough
Esquiman Channel
Sept-Îles
Jacques Cartier Strait
Anticosti Gyre
Beaugé Bank
Anticosti Channel
Anticosti Island
Pointe-des-Monts
Laurentian Channel
Gaspé
Gaspé Peninsula
Saguenay
Lower Estuary
Rimouski
Corner Brook
Newfoundland and Labrador
St. George's Bay
Chaleur Bay
Magdalen Shelf
Îles de la Madeleine
200 m
Bathurst
Acadian Peninsula
Québec
Upper Estuary
Cabot Strait
New Brunswick
Prince Edward Island
Laurentian Channel
Atlantic Ocean
Charlottetown
Cape Breton
U.S.A.
Moncton
Northumberland Strait
St. George's Bay
Nova Scotia
0
65
130
260
km

Source: Fisheries and Oceans Canada
Projection: UTM zone 20N, NAD83

Figure 1. Gulf of St. Lawrence Large Ocean Management Area (LOMA).

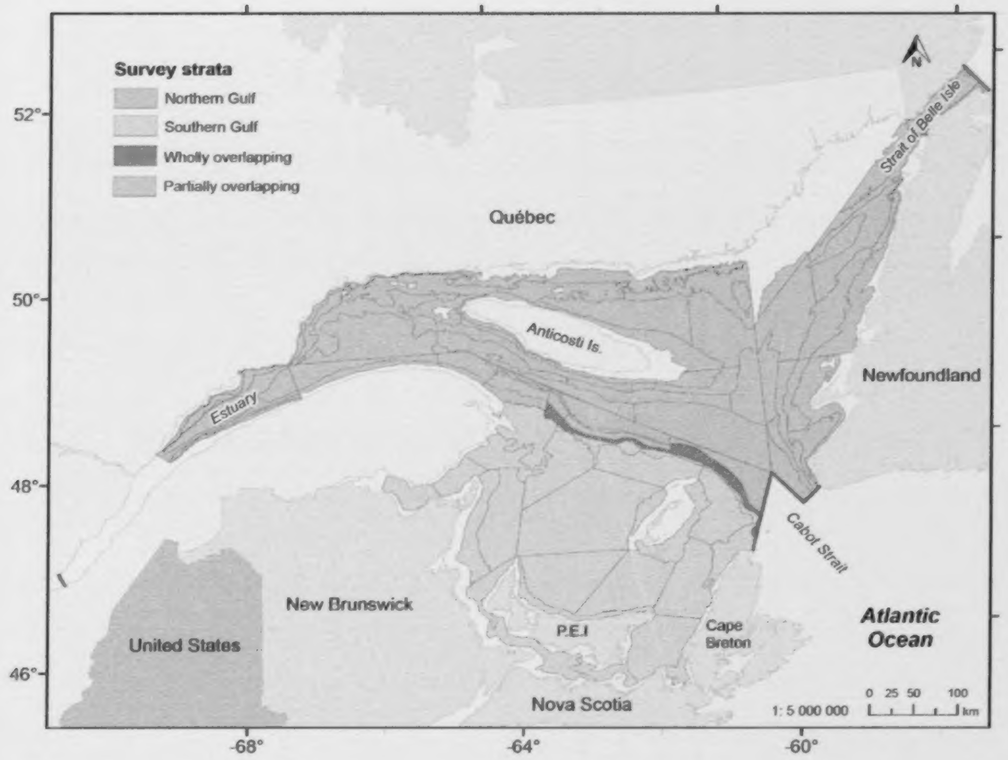

Survey strata
Northern Gulf
Southern Gulf
Wholly overlapping
Partially overlapping
Québec
Anticosti Is.
Estuary
Strait of Belle Isle
Newfoundland
Cabot Strait
New Brunswick
United States
P.E.I
Cape Breton
Atlantic Ocean
Nova Scotia
1: 5 000 000
0 25 50 100 km
52°
50°
48°
46°
-68°
-64°
-60°
N

Figure 2. The northern and southern regions of the Gulf of St. Lawrence as covered by the annual bottom trawl surveys.

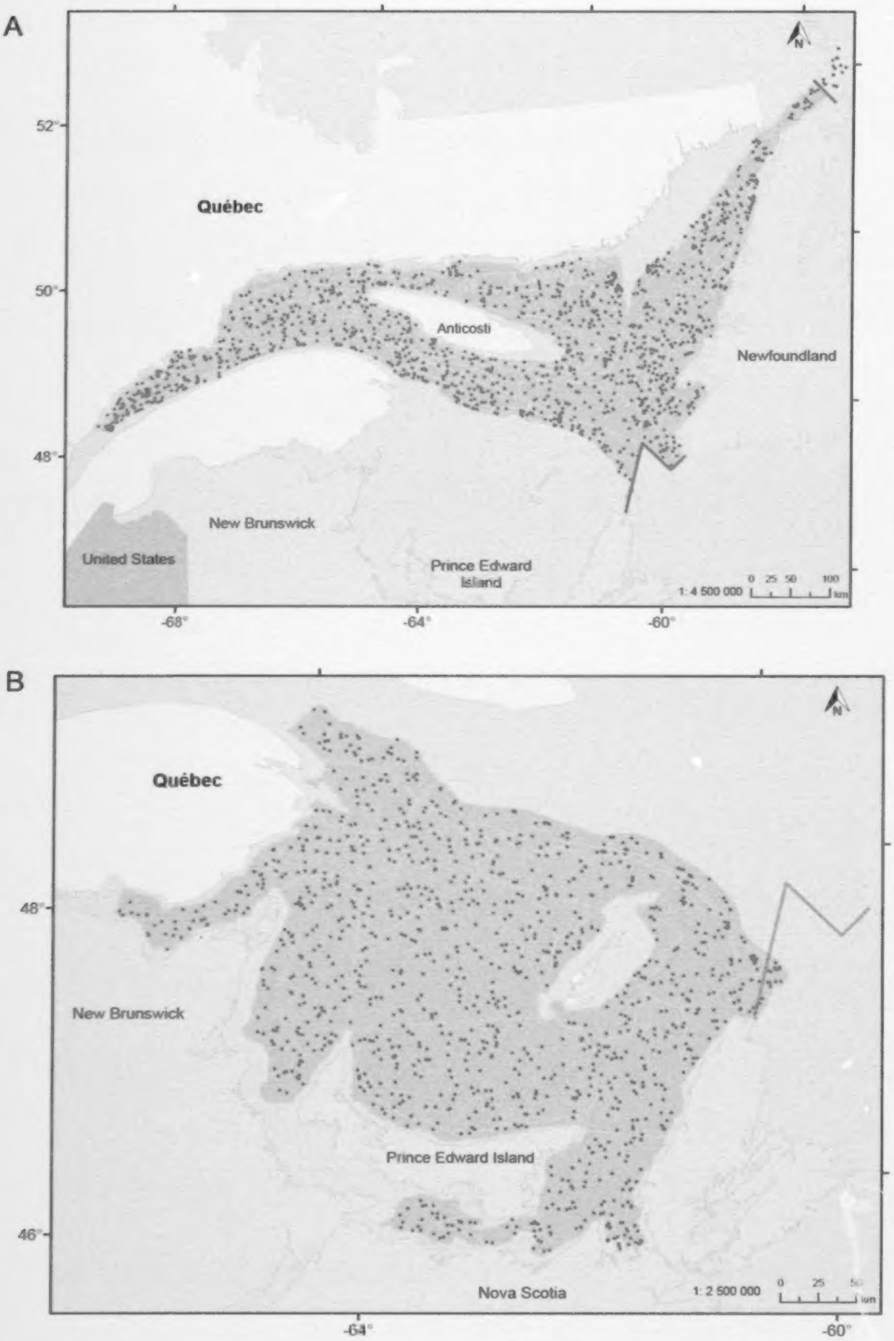

A
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
1: 4 500 000
0 25 50 100 km
52°
50°
48°
-68°
-64°
-60°
B
Québec
New Brunswick
Prince Edward Island
Nova Scotia
1: 2 500 000
0 25 50 km
48°
46°
-64°
-60°

Figure 3. Distribution of stations for bottom trawl surveys from 2006 to 2012 in the (A) Northern Gulf and (B) Southern Gulf. Shaded: spatial area mask.

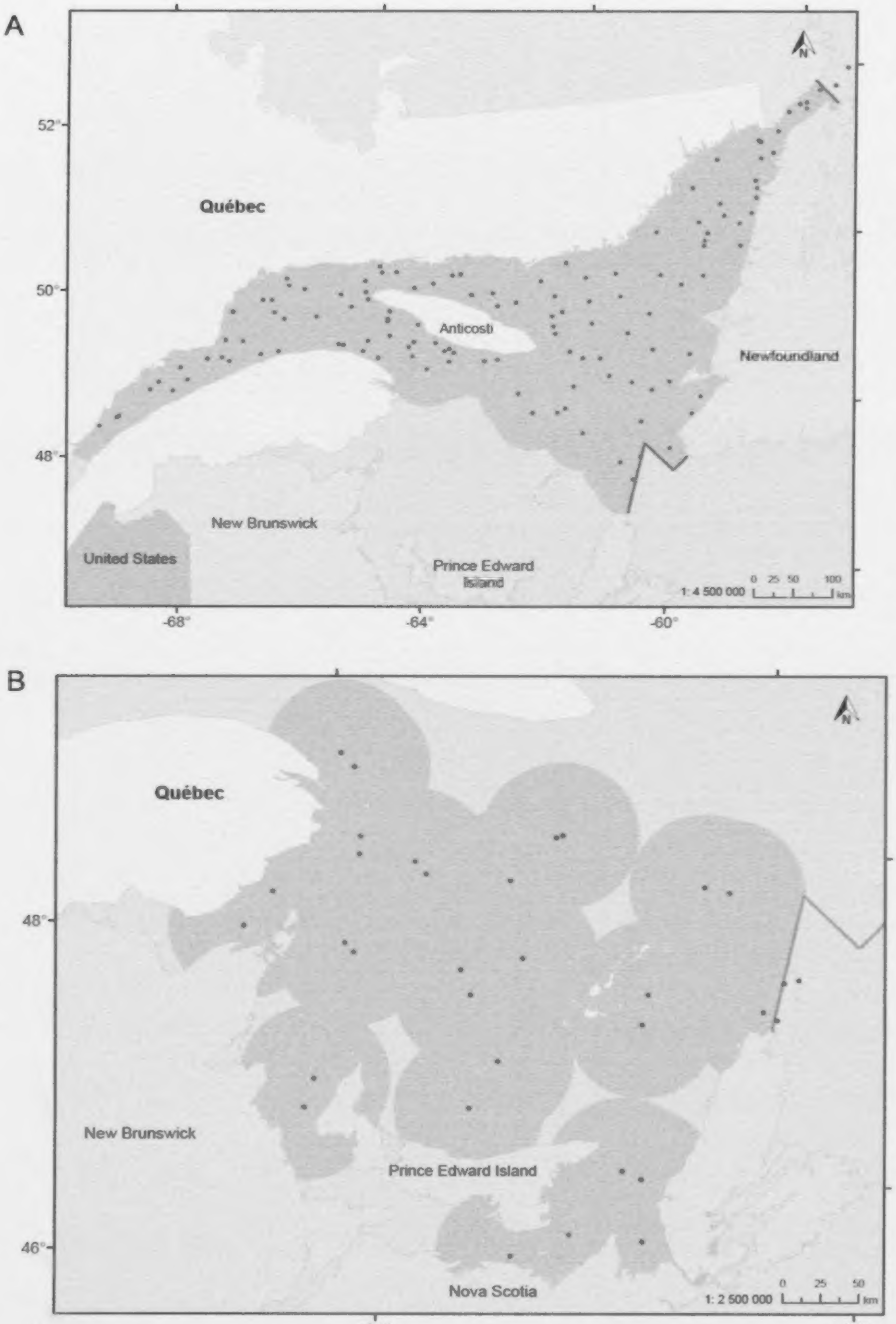

A
52°
50°
48°
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
N
0 25 50 100
1: 4 500 000
km
-68°
-64°
-60°
B
48°
46°
Québec
New Brunswick
Prince Edward Island
Nova Scotia
N
0 25 50
1: 2 500 000
km
-64°
-60°

Figure 4. Distribution of stations for zooplankton sampling from 2006 to 2007 in the (A) Northern Gulf and (B) Southern Gulf. Shaded: spatial area mask.

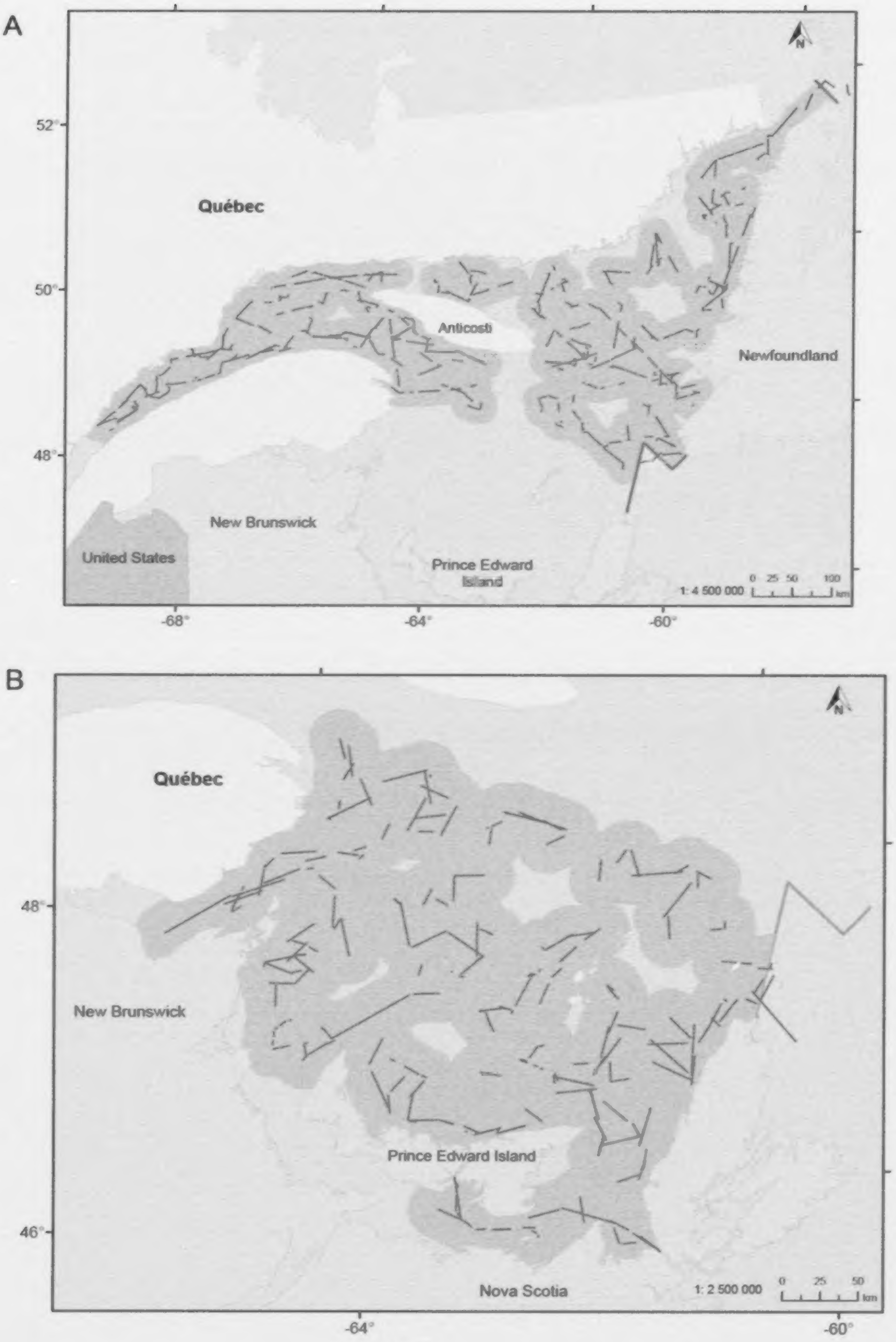

A
52°
50°
48°
-68°
-64°
-60°
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
1: 4 500 000
0 25 50 100 km
N
B
48°
46°
-64°
-60°
Québec
New Brunswick
Prince Edward Island
Nova Scotia
1: 2 500 000
0 25 50 km
N

Figure 5. Distribution of stations for zooplankton sampling from 2006 to 2007 in the (A) Northern Gulf and (B) Southern Gulf. Shaded: spatial area mask.

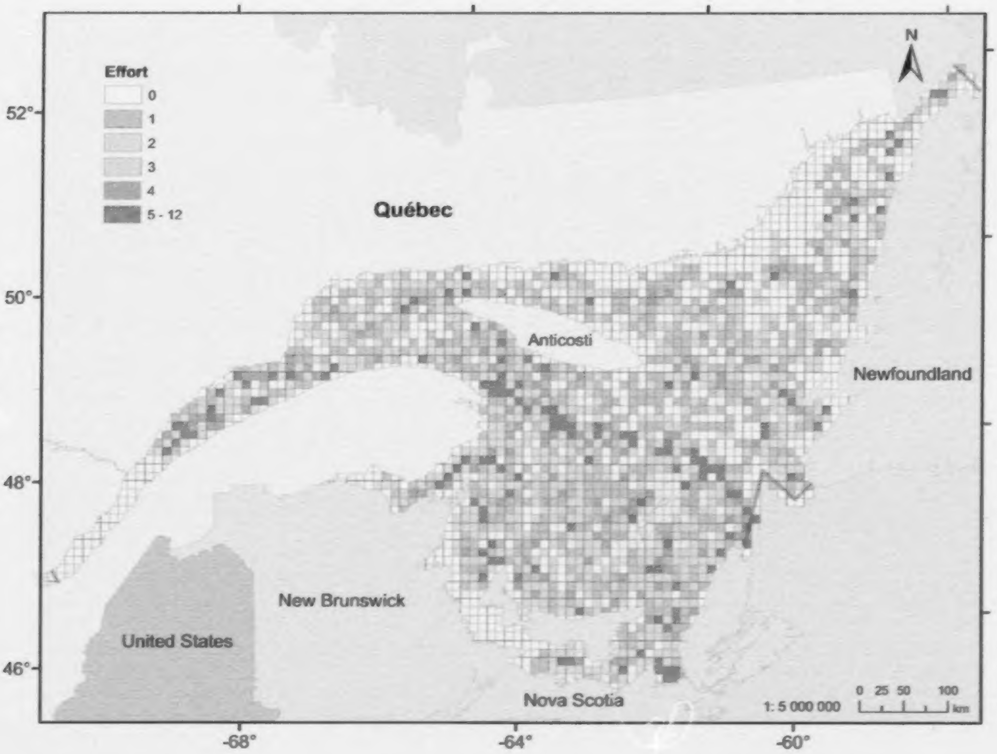

Effort
0
1
2
3
4
5 - 12
N
Québec
Anticosti
Newfoundland
New Brunswick
United States
Nova Scotia
52°
50°
48°
46°
-68°
-64°
-60°
1: 5 000 000
0 25 50 100 km

Figure 6. Sampling intensity plotted by 10 km cells in the study area. Colour scale indicates the sum of samples (trawl, zooplankton, and seabird observations) in the cell.

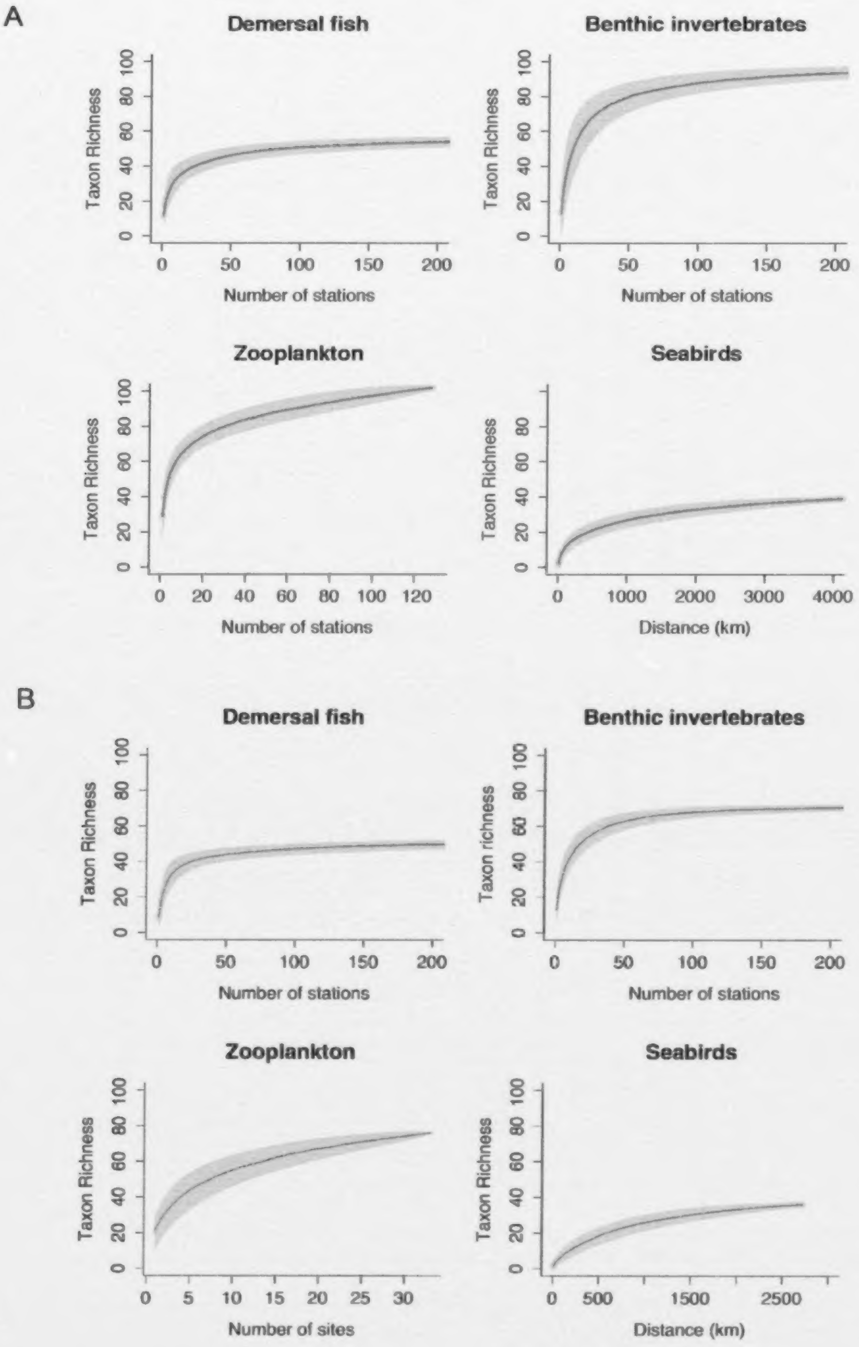


Figure 7. Taxon accumulation curves for groups in the Northern (A) and Southern (B) Gulf. Demersal fish and benthic invertebrate curves were truncated at 200 stations (shaded = 95% confidence intervals).

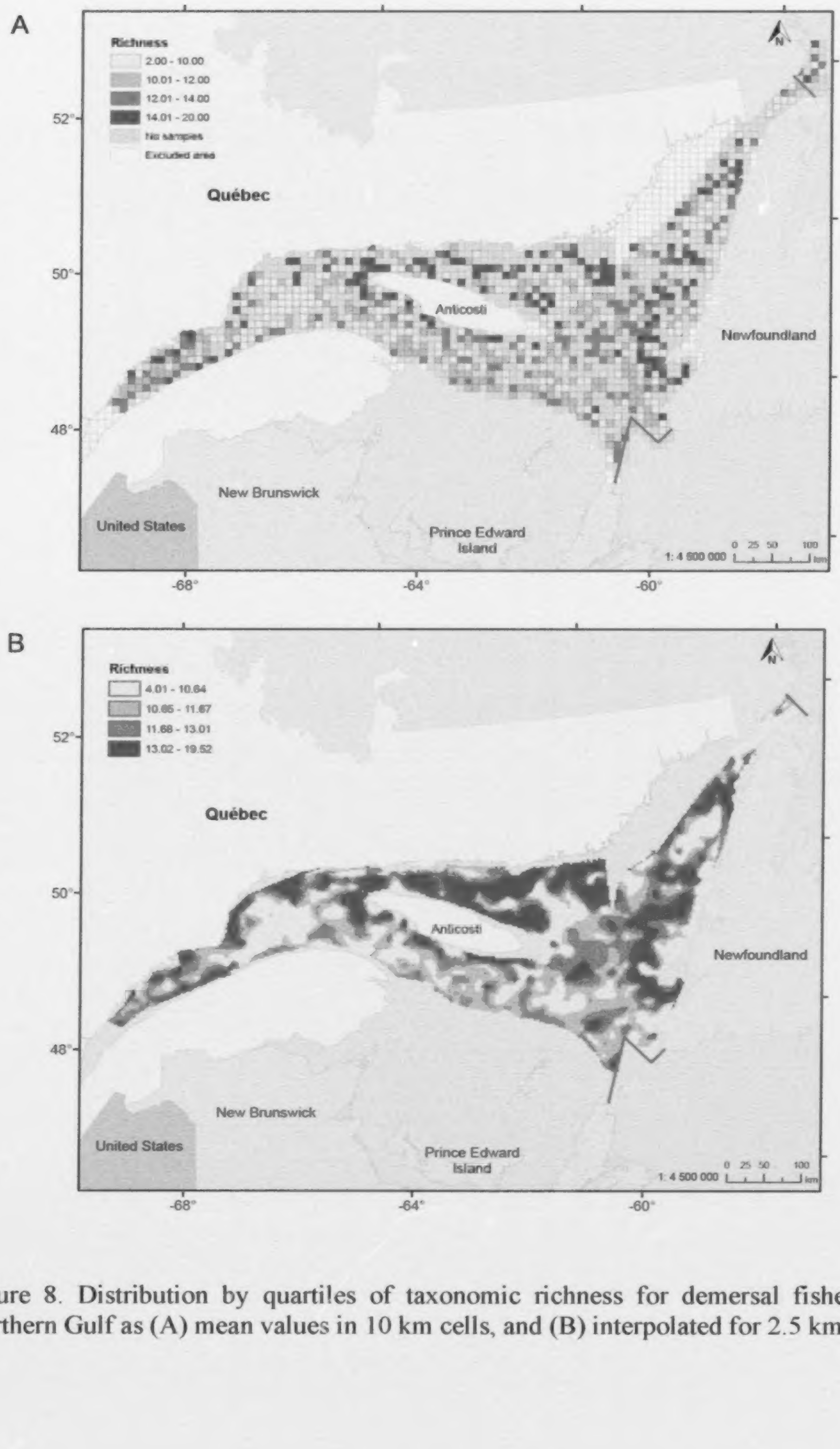

A
Richness
2.00 - 10.00
10.01 - 12.00
12.01 - 14.00
14.01 - 20.00
No samples
Excluded area
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
1: 4 500 000
0 25 50 100 km
52°
50°
48°
-68°
-64°
-60°
B
Richness
4.01 - 10.64
10.65 - 11.67
11.68 - 13.01
13.02 - 19.52
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
1: 4 500 000
0 25 50 100 km
52°
50°
48°
-68°
-64°
-60°

Figure 8. Distribution by quartiles of taxonomic richness for demersal fishes in the Northern Gulf as (A) mean values in 10 km cells, and (B) interpolated for 2.5 km cells.

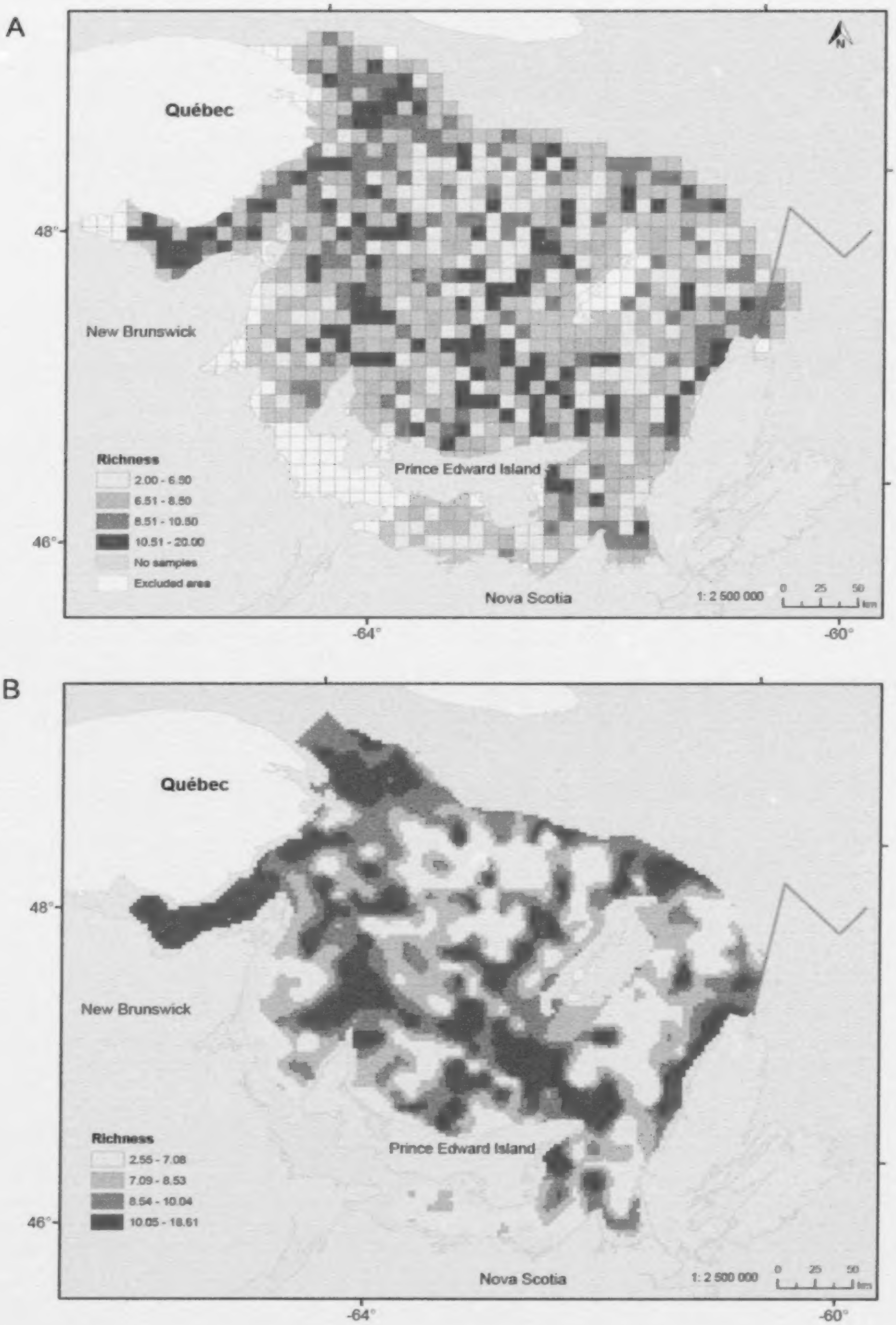

A
Québec
48°
New Brunswick
Prince Edward Island
Richness
2.00 - 6.50
6.51 - 8.50
8.51 - 10.50
10.51 - 20.00
No samples
Excluded area
46°
Nova Scotia
1: 2 500 000
0 25 50
km
-64°
-60°
B
Québec
48°
New Brunswick
Prince Edward Island
Richness
2.55 - 7.08
7.09 - 8.53
8.54 - 10.04
10.05 - 18.61
46°
Nova Scotia
1: 2 500 000
0 25 50
km
-64°
-60°

Figure 9. Distribution by quartiles of taxonomic richness for demersal fishes in the Southern Gulf as (A) mean values in 10 km cells, and (B) interpolated for 2.5 km cells.

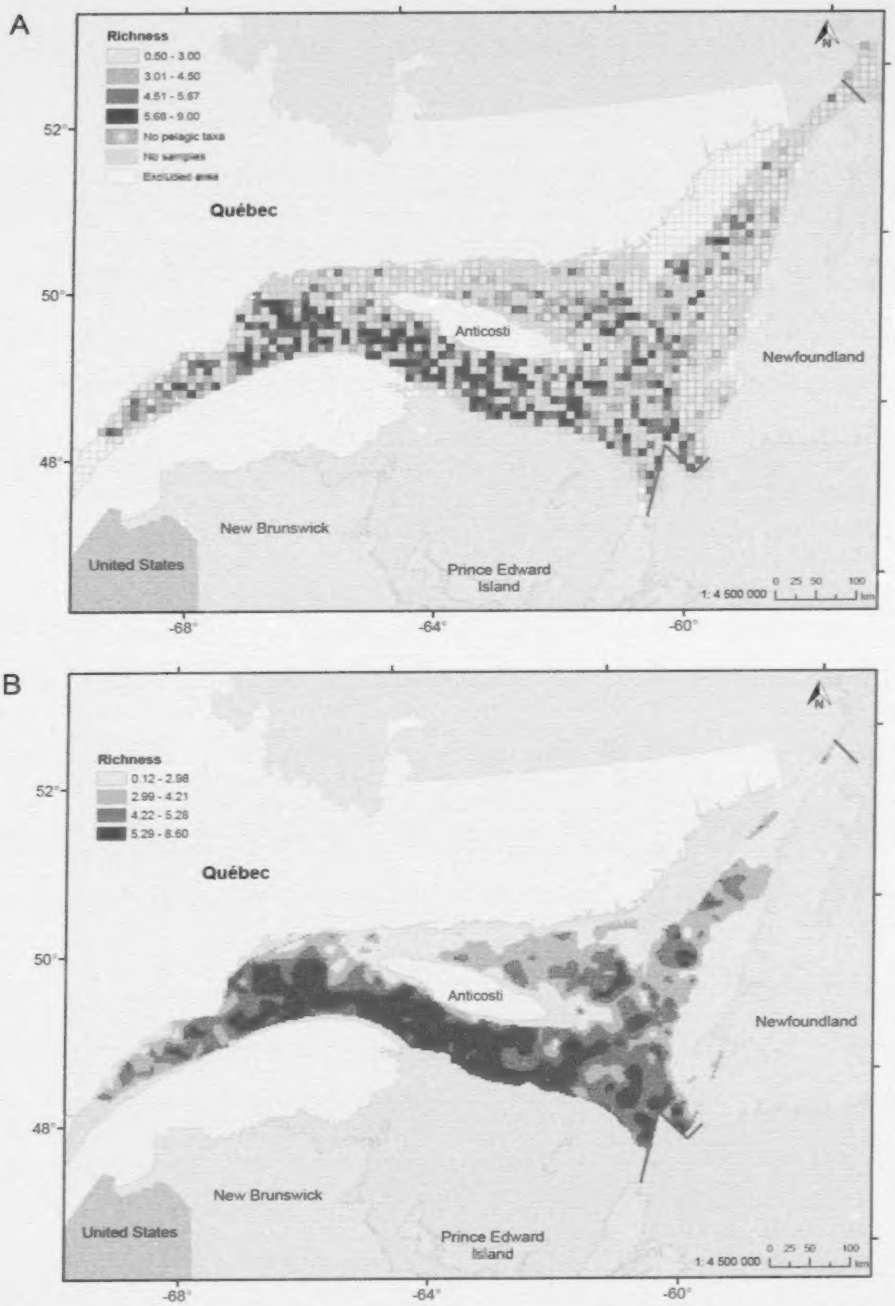

A
Richness
0.50 - 3.00
3.01 - 4.50
4.51 - 5.67
5.68 - 9.00
No pelagic taxa
No samples
Excluded area
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
1: 4 500 000
0 25 50 100 km
52°
50°
48°
-68°
-64°
-60°
B
Richness
0.12 - 2.98
2.99 - 4.21
4.22 - 5.28
5.29 - 8.60
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
1: 4 500 000
0 25 50 100 km
52°
50°
48°
-68°
-64°
-60°

Figure 10. Distribution by quartiles of taxonomic richness for pelagic taxa in the Northern Gulf as (A) mean values in 10 km cells, and (B) interpolated for 2.5 km cells.

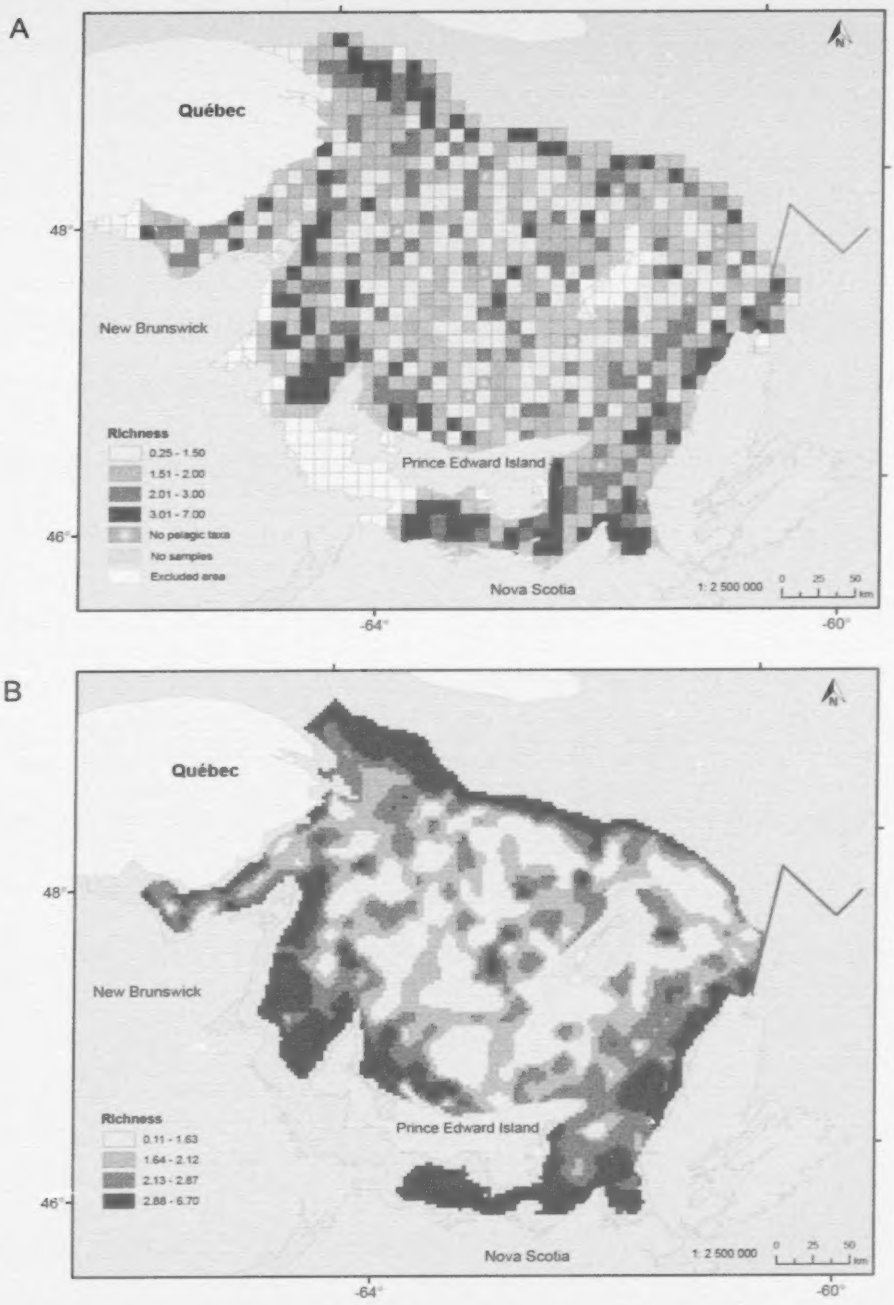

A
Québec
New Brunswick
Prince Edward Island
Nova Scotia
Richness
0.25 - 1.50
1.51 - 2.00
2.01 - 3.00
3.01 - 7.00
No pelagic taxa
No samples
Excluded area
48°
46°
-64°
-60°
1: 2 500 000
0 25 50 km
B
Québec
New Brunswick
Prince Edward Island
Nova Scotia
Richness
0.11 - 1.63
1.64 - 2.12
2.13 - 2.87
2.88 - 6.70
48°
46°
-64°
-60°
1: 2 500 000
0 25 50 km

Figure 11. Distribution by quartiles of taxonomic richness for pelagic taxa in the Southern Gulf as (A) mean values in 10 km cells, and (B) interpolated for 2.5 km cells.

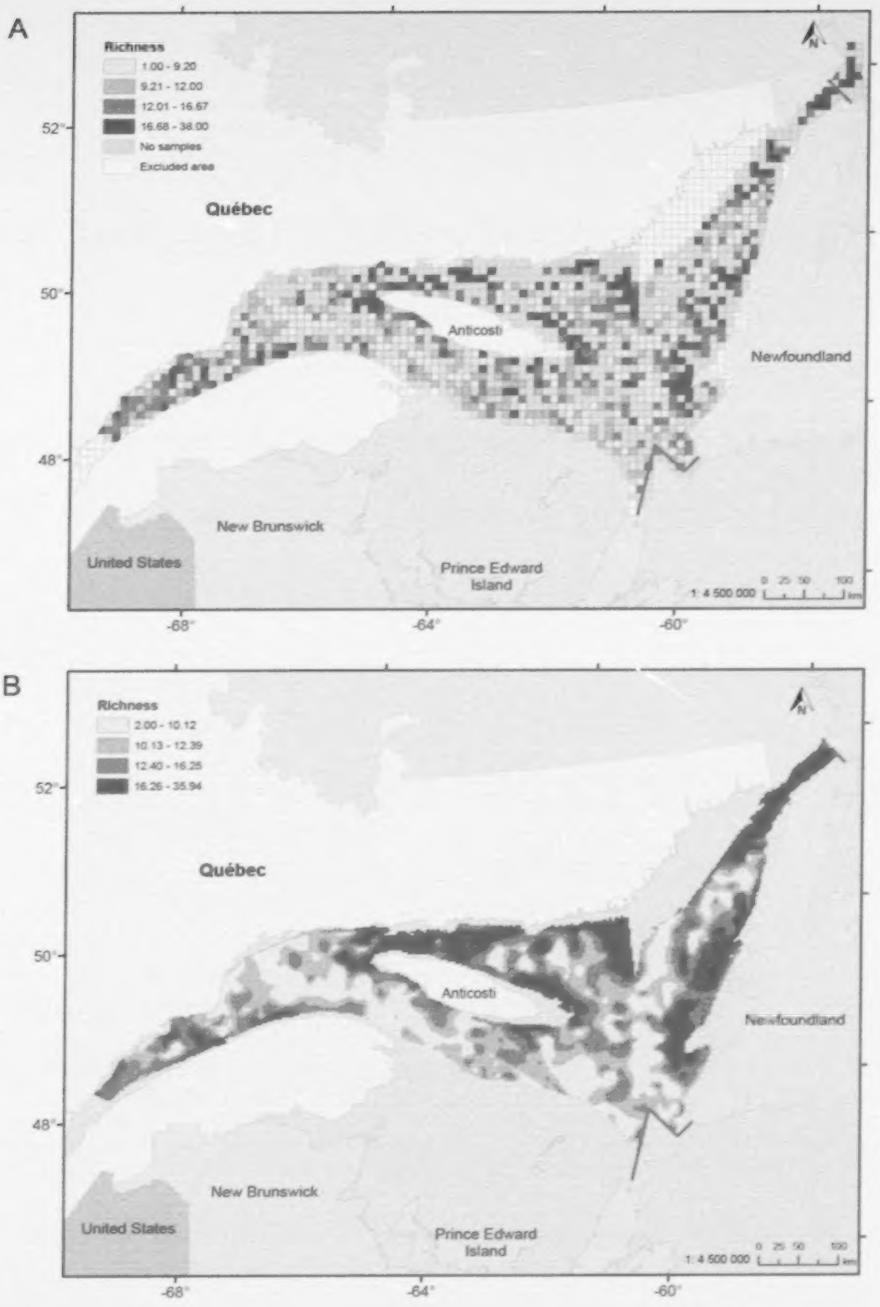

A
Richness
1.00 - 9.20
9.21 - 12.00
12.01 - 16.67
16.68 - 38.00
No samples
Excluded area
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
1: 4 500 000
0 25 50 100 km
52°
50°
48°
-68°
-64°
-60°
B
Richness
2.00 - 10.12
10.13 - 12.39
12.40 - 16.25
16.26 - 35.94
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
1: 4 500 000
0 25 50 100 km
52°
50°
48°
-68°
-64°
-60°

Figure 12. Distribution by quartiles of taxonomic richness for benthic invertebrates in the Northern Gulf as (A) mean values in 10 km cells, and (B) interpolated for 2.5 km cells.

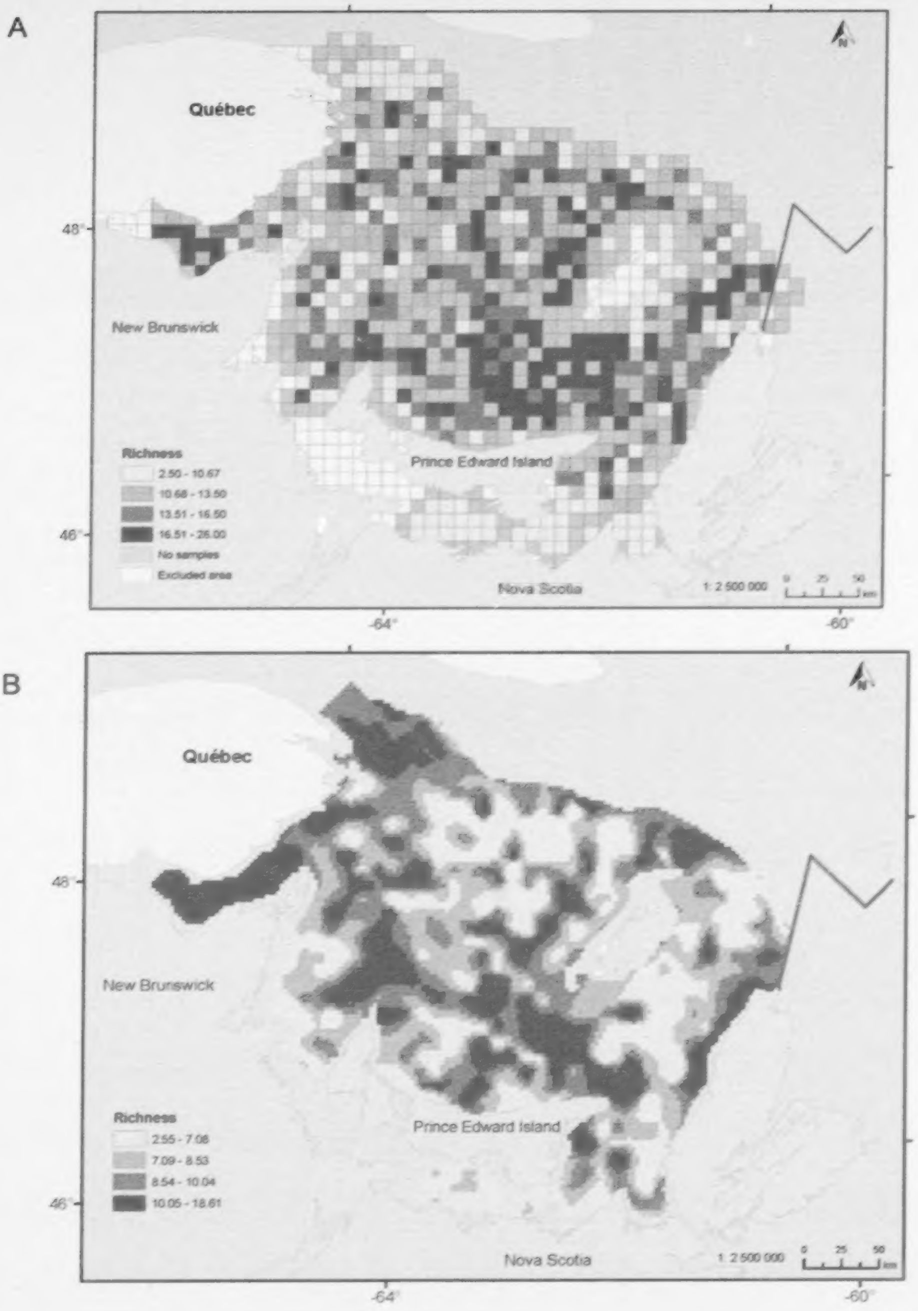

A
Québec
New Brunswick
Prince Edward Island
Nova Scotia
48°
46°
-64°
-60°
N
Richness
2.50 - 10.67
10.68 - 13.50
13.51 - 16.50
16.51 - 26.00
No samples
Excluded area
1: 2 500 000
0 25 50 km
B
Québec
New Brunswick
Prince Edward Island
Nova Scotia
48°
46°
-64°
-60°
N
Richness
2.55 - 7.08
7.09 - 8.53
8.54 - 10.04
10.05 - 18.61
1: 2 500 000
0 25 50 km

Figure 13. Distribution by quartiles of taxonomic richness for benthic invertebrates in the Southern Gulf as (A) mean values in 10 km cells, and (B) interpolated for 2.5 km cells.

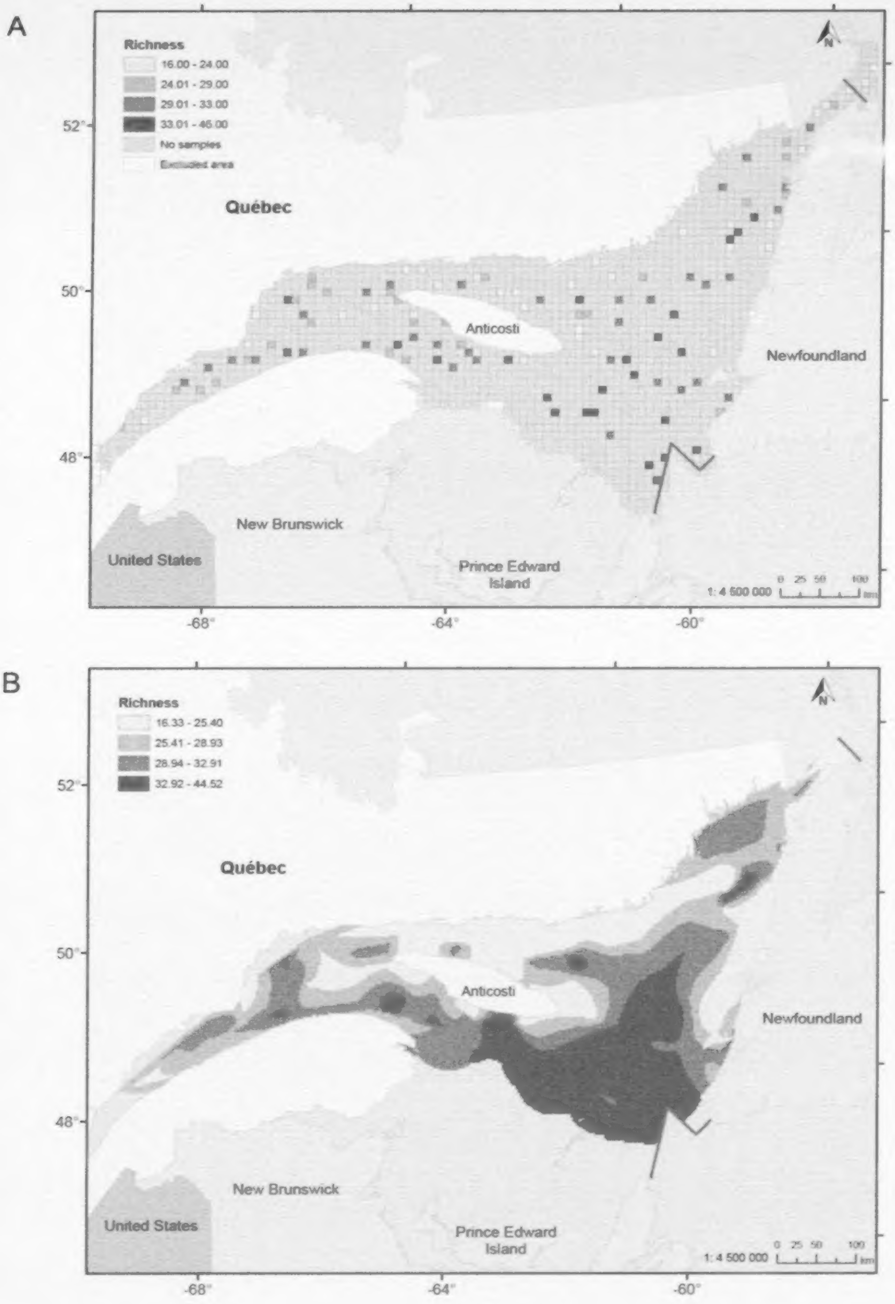

A
Richness
16.00 - 24.00
24.01 - 29.00
29.01 - 33.00
33.01 - 46.00
No samples
Excluded area
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
1: 4 500 000
0 25 50 100 km
52°
50°
48°
-68°
-64°
-60°
B
Richness
16.33 - 25.40
25.41 - 28.93
28.94 - 32.91
32.92 - 44.52
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
1: 4 500 000
0 25 50 100 km
52°
50°
48°
-68°
-64°
-60°

Figure 14. Distribution by quartiles of taxonomic richness for zooplankton in the Northern Gulf as A) mean values in 10 km cells, and B) interpolated for 2.5 km cells.

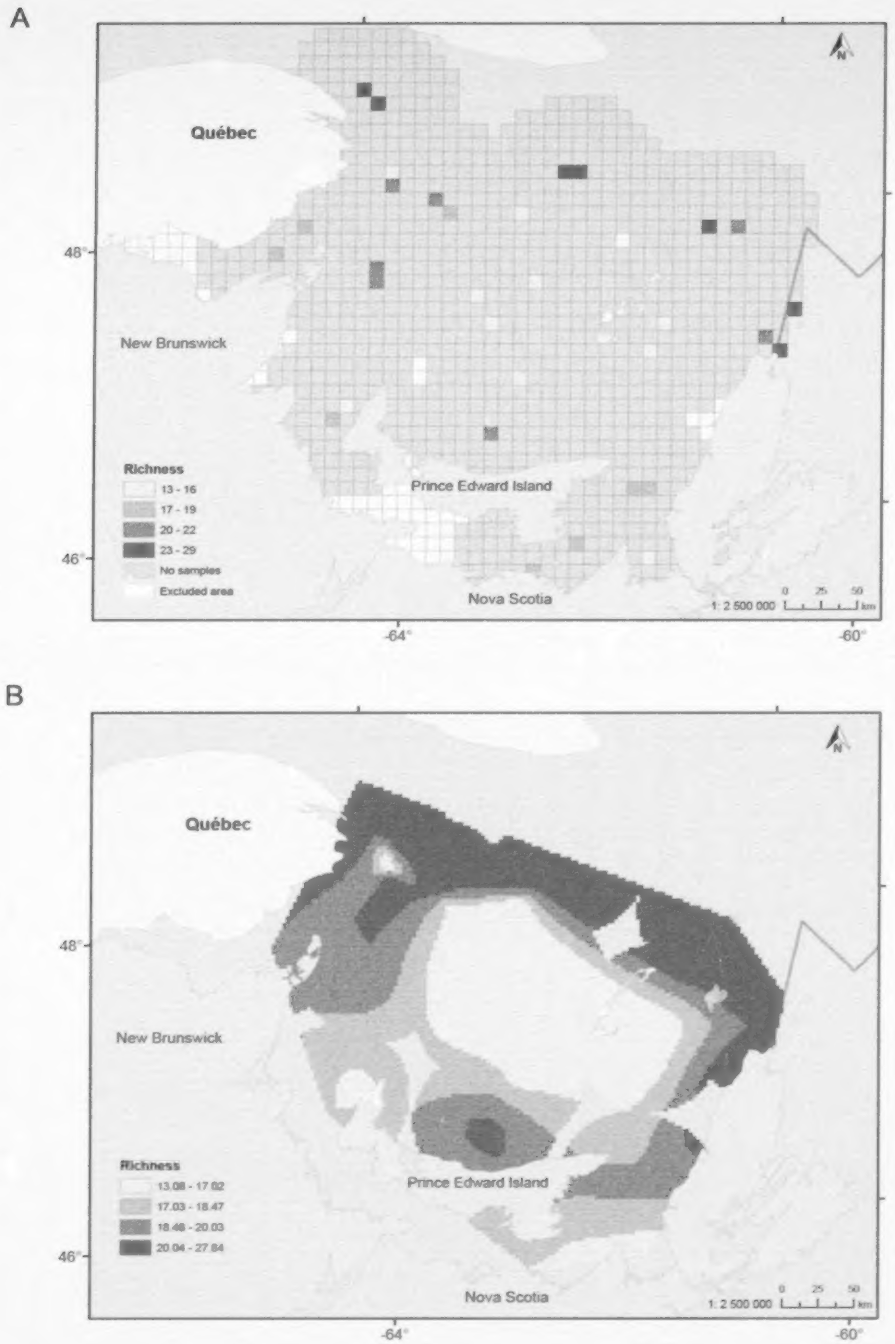

A
Québec
New Brunswick
Prince Edward Island
Nova Scotia
48°
46°
-64°
-60°
N
Richness
13 - 16
17 - 19
20 - 22
23 - 29
No samples
Excluded area
1: 2 500 000
0 25 50 km
B
Québec
New Brunswick
Prince Edward Island
Nova Scotia
48°
46°
-64°
-60°
N
Richness
13.08 - 17.02
17.03 - 18.47
18.48 - 20.03
20.04 - 27.84
1: 2 500 000
0 25 50 km

Figure 15. Distribution by quartiles of taxonomic richness by station for zooplankton in the Southern Gulf in A) 10 km cells, and B) interpolated for 2.5 km cells.

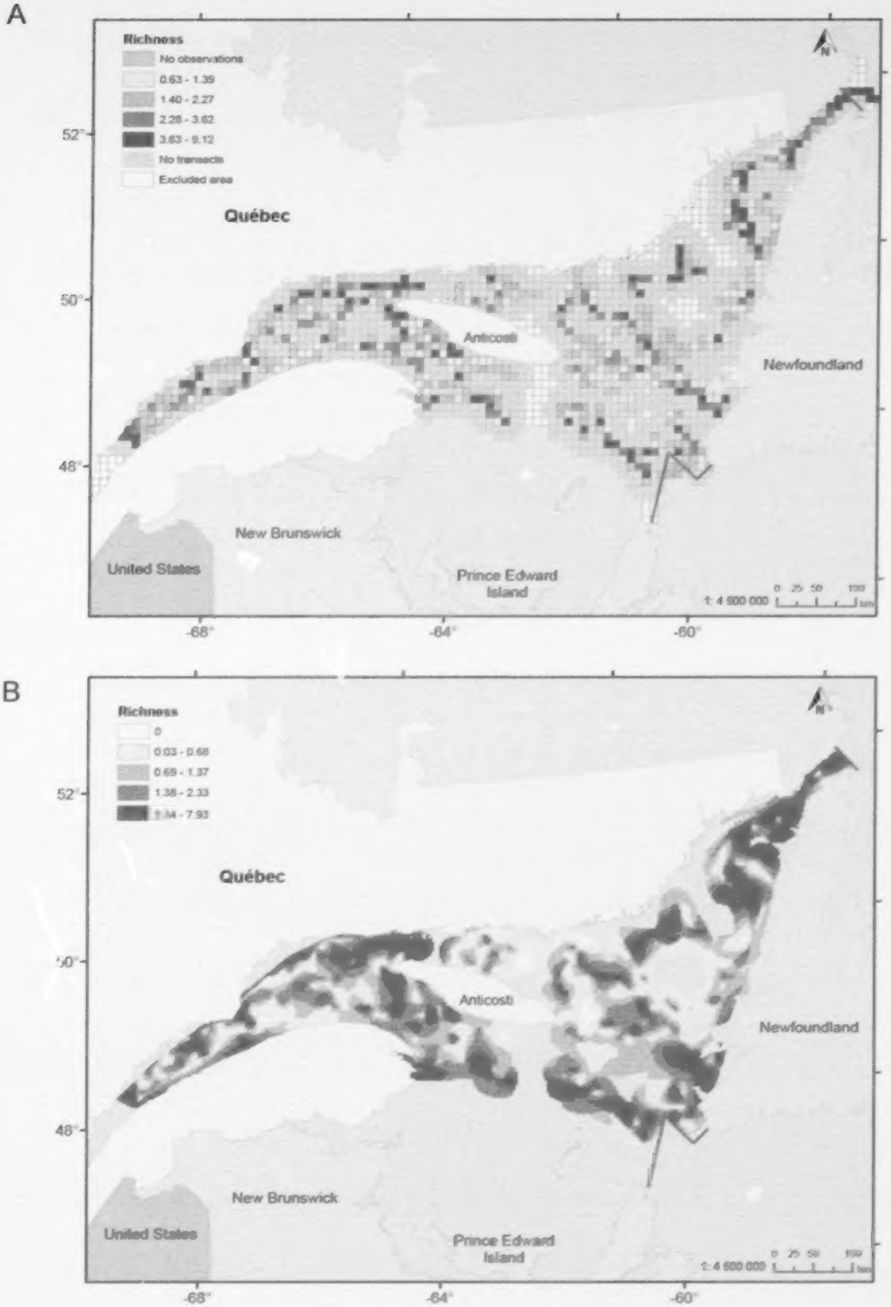

A
Richness
No observations
0.63 - 1.39
1.40 - 2.27
2.28 - 3.62
3.63 - 9.12
No transects
Excluded area
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
N
0 25 50 100
1: 4 500 000
km
52°
50°
48°
-68°
-64°
-60°
B
Richness
0
0.03 - 0.68
0.69 - 1.37
1.38 - 2.33
2.34 - 7.93
Québec
Anticosti
Newfoundland
New Brunswick
United States
Prince Edward Island
N
0 25 50 100
1: 4 500 000
km
52°
50°
48°
-68°
-64°
-60°

Figure 16. Distribution by quartiles of taxonomic richness for seabirds in the Northern Gulf as A) mean values in 10 km cells, and B) interpolated for 2.5 km cells.

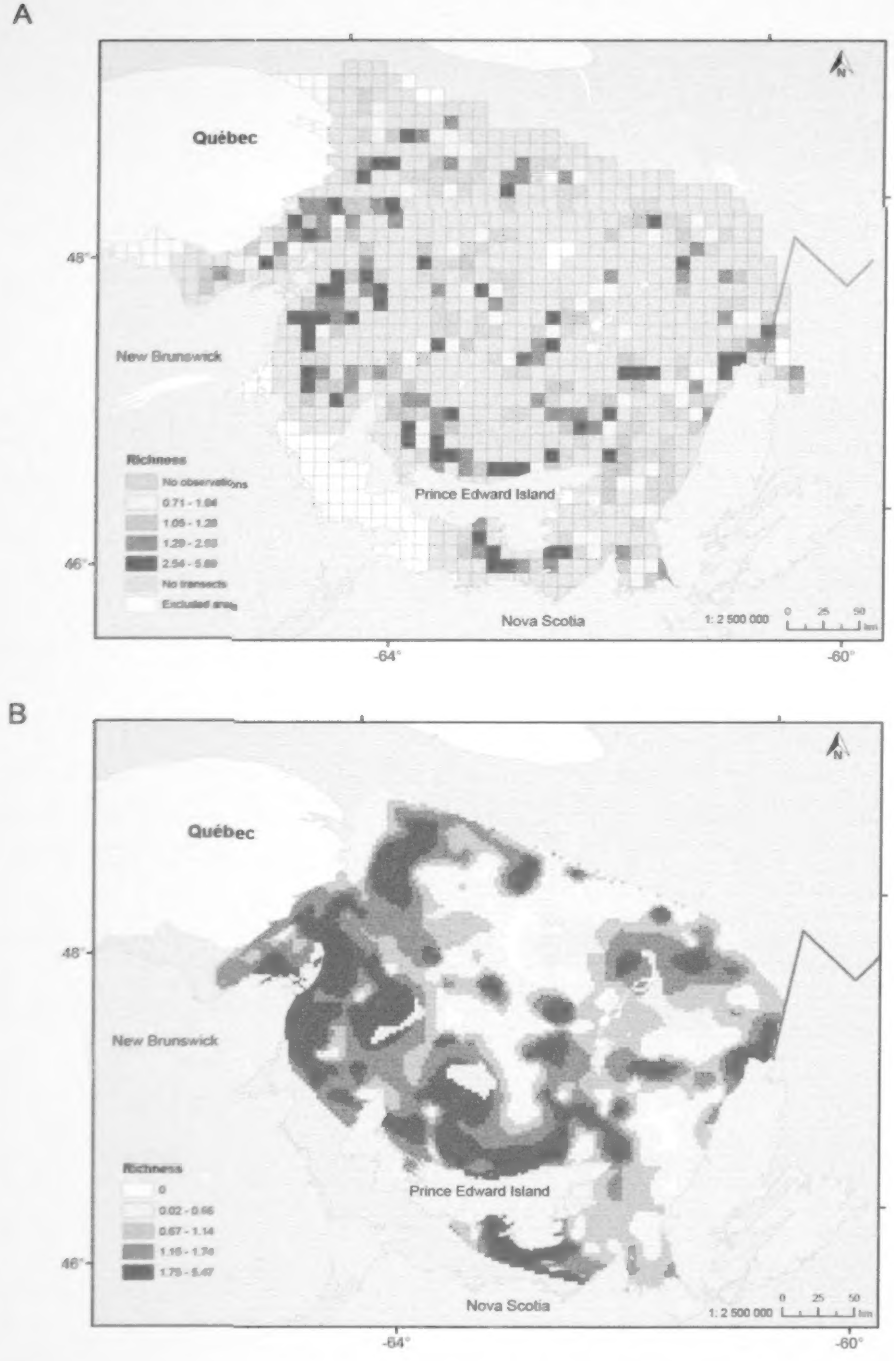

A
Québec
48°
New Brunswick
Richness
No observations
0.71 - 1.04
1.05 - 1.28
1.29 - 2.53
2.54 - 5.89
No transects
Excluded area
Prince Edward Island
46°
Nova Scotia
1: 2 500 000
0 25 50 km
-64°
-60°
B
Québec
48°
New Brunswick
Richness
0
0.02 - 0.66
0.67 - 1.14
1.16 - 1.74
1.75 - 5.47
Prince Edward Island
46°
Nova Scotia
1: 2 500 000
0 25 50 km
-64°
-60°

Figure 17. Distribution by quartiles of taxonomic richness for seabirds in the Southern Gulf as A) mean values in 10 km cells, and B) interpolated for 2.5 km cells.

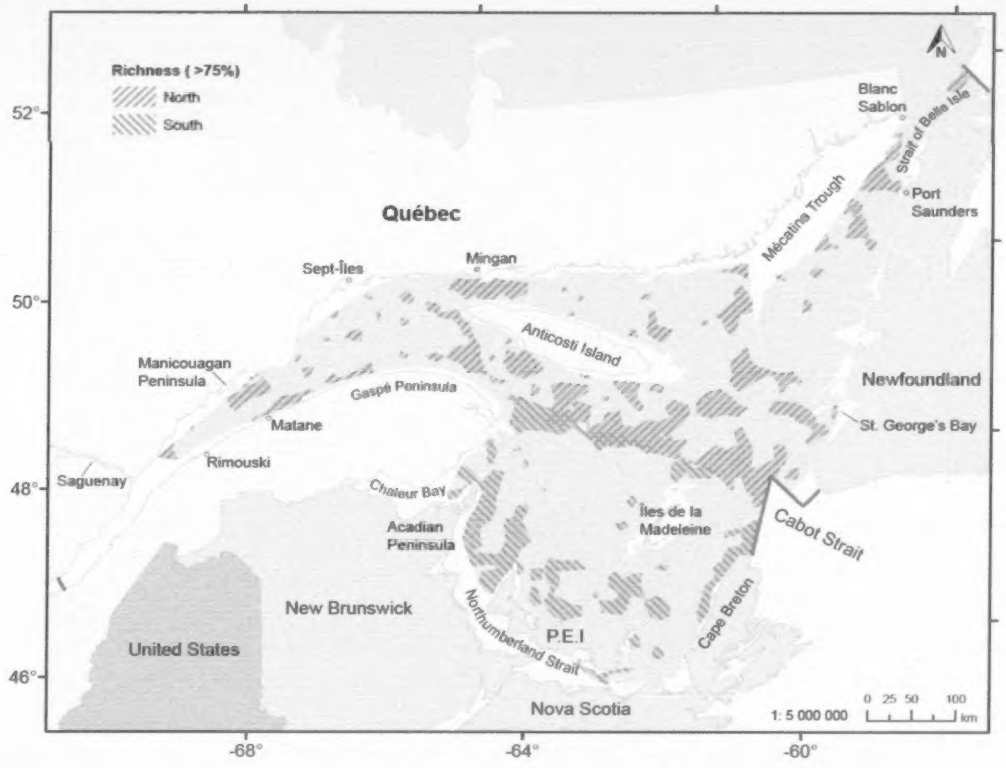

Richness (>75%)
▨ North
▨ South
Québec
Sept-Îles
Mingan
Blanc Sablon
Strait of Belle Isle
Port Saunders
Mécatina Trough
Anticosti Island
Manicouagan Peninsula
Gaspé Peninsula
Matane
Rimouski
Saguenay
Newfoundland
St. George's Bay
Chaleur Bay
Acadian Peninsula
Îles de la Madeleine
Cabot Strait
Cape Breton
New Brunswick
United States
P.E.I
Northumberland Strait
Nova Scotia
1: 5 000 000
0 25 50 100 km
52°
50°
48°
46°
-68°
-64°
-60°

Figure 18. Areas presenting high taxon richness (>75th percentile) across all groups for both Northern and Southern Gulf regions (red hatched lines).

APPENDICES

APPENDIX 1: DATA STANDARDIZATION - NGSL TRAWL SURVEYS

Northern Gulf of St. Lawrence fishes

List by survey code of problematic fish taxa in bottom trawl captures for the 2006–2012 period, including remarks, suggested corrections, and suitability for analyses.

12 *Myxine glutinosa*
Northern hagfish. Frequent records. Deepwater scavenger. A few records at <200 m depth, possibly due to net entanglement.
Database: no action, review records >130 m.
Analysis: demersal.

15 *Petromyzon marinus*
Sea lamprey, two records. Migratory pelagic species.
Database: no action.
Analysis: demersal; exclude as rare.

24 *Squalus acanthias*
Spiny dogfish, seven records, at sites >200 m. Pelagic species. Larger sharks (Greenland shark, porbeagle, basking shark) were very rare in captures and released (not recorded).
Database: no action.
Analysis: pelagic; exclude as rare for certain analyses.

27 *Centroscyllium fabricii*
Black dogfish. Frequent records at depths >300 m, most often in large quantities and sizes; several instances of small single individuals.
Database: no action, review small records.
Analysis: demersal.

94 *Rajella fyllae*
Round skate, 10 records since 2007 of 1 or 2 specimens, for catches of 8 to 730 g, at depths of 220-391 m. Prior records were misidentified as *Leucoraja ocellata.* An exception was 1 specimen of 2.5 kg caught in 2008 at 88 m off the west coast of Newfoundland, with a photo confirming it as *L. ocellata.*
Database: change the 2008 record for *L. ocellata* **(100)**
Analysis: demersal; exclude as rare for some analyses.

100 *Leucoraja ocellata*
Winter skate, one record in 2006 off the west coast of Newfoundland. Often misidentified as thorny skate (*A. radiata*) or round skate, except for a large specimen in 2008 that was in fact a winter skate but mistakenly recorded as round skate. This is the only positive record to date of winter skate in the Northern Gulf surveys.
Database: evaluate records using photos or length-weight regressions for *L. ocellata* (large species) vs *R. fyllae* (smaller, long-tailed species).
Analysis: exclude.

152 *Alosa sapidissima*
American shad, two shallow-water records in 2011 (6 individuals, 69 m) and 2012 (one individual, 73 m). Most as small juveniles. Nearshore pelagic species.
Database: no action.
Analysis: pelagic; exclude as rare (coastal).

168 *Xenodermichthys copei*
Bluntsnout smoothhead, three records at depths >200 m in 2011–2012. Mesopelagic species from Atlantic Ocean, not previously recorded in the Gulf.
Database: no action.
Analysis: pelagic; exclude as rare or mesopelagic.

188 *Osmerus mordax*
Rainbow smelt, one record in 2008 at depth of 241 m. Nearshore pelagic species.
Database: no action.
Analysis: pelagic; exclude as rare (coastal).

193 *Argentina silus*
Atlantic argentine, several records in small numbers at depths >200 m. Small specimens may be mistaken for more common species.
Database: no action.
Analysis: pelagic; exclude as rare for some analyses.

205 Gonostomatidae
Lightfishes (family), 26 records at depths > 250 m; 2 at 129 and 174 m. Most records from 2009. Fragile and small mesopelagic stomiiformes, usually captured in poor condition. Assumed to refer to the common species, *Cyclothone microdon*.
Database: update common names to specify if referring to family or genus *Cyclothone*.
Analysis: pelagic; exclude as mesopelagic for some analyses.

208 *Cyclothone microdon*
Very small gonostomatid, 29 records at depths >250 m, most from 2011. Abundant mesopelagic species, poorly represented in bottom trawls.
Database: no action.
Analysis: pelagic; exclude as mesopelagic for some analyses.

214 *Maurolicus muelleri*
Pearlside (hatchetfish, Sternoptychidae), one record at 241 m depth. Mesopelagic species.
Database: no action.
Analysis: pelagic; exclude as rare or mesopelagic.

220 Sternoptychidae
Hatchetfishes, four records at depths >250 m. Mesopelagic species. Likely refers to specimens in poor condition of *Polyipnus clarus* or *Agrypelecus* sp.
Database: no action.
Analysis: pelagic; exclude as mesopelagic for some analyses.

222 *Polyipnus clarus*

Slope hatchetfish, 12 records at depths >250 m. Mesopelagic species. Revised species from previous *Polyipnus asteroides*.

Database: no action.

Analysis: pelagic; exclude as mesopelagic for some analyses.

225 *Argyropelecus gigas*

Hatchetfish, one record at 328 m depth. Mesopelagic species. No other species in the genus have been confirmed to date.

Database: no action.

Analysis: pelagic; exclude as rare.

227 *Chauliodus sloani*

Sloane's viperfish, five records. Mesopelagic species. A specimen of 1.6 g in 2010.

Database: no action; review the small specimen for future confirmation.

Analysis: pelagic; exclude as mesopelagic for some analyses.

230 *Stomias boa*

Boa dragonfish, five records. Mesopelagic species. For review: one specimen of 1.7 g, another at 156 m.

Database: no action.

Analysis: pelagic; exclude as mesopelagic for some analyses.

271 Myctophiformes

Deepwater fishes, one record in 2006. Capture of 14.9 g. Uncertain record.

Database: no action.

Analysis: pelagic; exclude as uncertain or as mesopelagic for some analyses.

272 Myctophidae

Lanternfishes, 91 records. Mesopelagic species, includes *Benthosema glaciale* and *Notoscopelus elongatus*.

Database: no action.

Analysis: pelagic; exclude as mesopelagic for some analyses.

273 *Notoscopelus* sp.

A large lanternfish (likely *N. elongatus*), two records in 2011. Mesopelagic species (Myctophidae). May be mistaken in name only for the dissimilar-looking *Neoscopelus* (Neoscopelidae).

Database: no action.

Analysis: pelagic; exclude as mesopelagic for some analyses.

278 *Neoscopelus macrolepidotus*

Glowingfish, two records in 2011. Mesopelagic species (Neoscopelidae).

Database: no action.

Analysis: pelagic; exclude as mesopelagic for some analyses.

285 *Lampadena speculigera*
Mirror lanternfish, three records. Mesopelagic species (Myctophidae).
Database: no action.
Analysis: pelagic; exclude as mesopelagic for some analyses.

368 *Nemichthys scolopaceus*
Snipe eel, six records. Mesopelagic species (Anguilliformes).
Database: no action.
Analysis: demersal; exclude as rare for some analyses.

369 *Serrivomer beanii*
Stout sawpalate, three records. Mesopelagic species (Anguilliformes).
Database: no action.
Analysis: demersal; exclude as rare for some analyses.

373 *Synaphobranchus kaupii*
Northern cutthroat eel, seven records. Mesopelagic species (Anguilliformes). A small specimen was captured at 71 m in 2012.
Database: review record at 2012, station 42.
Analysis: demersal; exclude as rare for some analyses.

398 *Scomberesox saurus*
Atlantic saury, 14 records, most in 2006. Warmwater pelagic species.
Database: no action.
Analysis: use as pelagic.

426 *Gasterosteus aculeatus*
Threespine stickleback, frequent records, usually as single inviduals, although some large abundance values should be reviewed.
Database: no action.
Analysis: use as pelagic.

430 Gadiformes
Codfish (order), one specimen of 0.4 g in 2009 at 83 m depth. Likely a *Gadus* juvenile, possibly conserved for analysis.
Database: no action; review to confirm if *Gadus* sp.
Analysis: exclude.

436 Gadidae
Codfish (family), five records of one specimen each; four were <1 g, likely *Gadus* juveniles that may have been conserved to verify identification. A fifth specimen of 67 g was captured in 2008 at 218 m depth.
Database: no action; review to confirm if *Gadus* sp.
Analysis: exclude.

439 ***Gadus ogac***

Greenland cod (ogac, rock cod). Frequent records. A solitary inshore species, with few captures at depths >100 m. One record of 8.5 g in 2009 at 286 m depth. Not reliably distinguished from *Gadus morhua* < 15 cm.

Database: records need confirmation when abundant in catch; also review specimens <20 cm, from depths >150 m, and >5 in number per tow.

Analysis: demersal; use specimens >20 cm.

440 ***Micromesistius poutassou***

Blue whiting, one record in 2006, at 411 m depth. A pelagic gadiforme from NE Atlantic. Positive identification.

Database: no action.

Analysis: pelagic; exclude (incidental).

441 ***Melannogrammus aeglefinus***

Haddock, 14 records. A southern species.

Database: no action.

Analysis: demersal; exclude as rare for some analyses.

442 ***Microgadus tomcod***

Atlantic tomcod, one record in 2010 at 69 m depth. Common inshore species.

Database: no action.

Analysis: demersal; exclude (coastal).

443 ***Pollachius virens***

Pollock, six records. A southern species; mostly pelagic.

Database: no action.

Analysis: pelagic; exclude as rare for other analyses.

449 ***Merluccius bilinearis***

Silver hake, frequent records, usually in low numbers of small specimens (15-25 cm length). A southern species; mostly pelagic. Record in 2008, station 199 in the Estuary at 304 m depth with capture of 48.4 kg for 1 individual. To review.

Database: review abberant capture record in in 2008.

Analysis: pelagic.

450 ***Boreogadus saida***

Arctic cod, frequent records. A coldwater, northern species from Labrador waters.

Database: no action.

Analysis: pelagic.

453 ***Gaidropsarus* sp.**

Threebeard rocklings, 25 records. Specimens were usually very small pelagic juveniles Demersal adults found in the Atlantic. Often mistaken for fourbeard rockling juveniles.

Database: review record in 2006, station 106, with 2 individuals for 759 g.

Analysis: exclude (rare pelagic juveniles, outside normal distribution).

454 ***Gaidropsarus ensis***
Threebeard rockling, two records. Small pelagic juveniles, no adults.
Database: no action.
Analysis: exclude (rare pelagic juveniles, outside normal distribution).

455 ***Gaidropsarus argentatus***
Silver rockling, 19 records. Small pelagic juveniles, no adults.
Database: no action.
Analysis: exclude (rare pelagic juveniles, outside normal distribution).

572 ***Scomber scombrus***
Atlantic mackerel, 56 records, usually of 1-3 individuals. Some unusual captures (e.g., 15.5 kg for 48 individuals, 0.22 kg for 17 individuals).
Database: Review large (>10 in number) captures.
Analysis: pelagic.

694 ***Ammodytes dubius***
Northern sand lance, one record in 2012. Large specimen. Offshore, semi-demersal species over sandy habitats; rarely captured in bottom trawl gear in Northern Gulf region. Difficult to identify to species unless examined minutely (number of lateral plicae).
Database: no action.
Analysis merge with *A. americanus* to genus *Ammodytes*; use as pelagic.

695 ***Ammodytes americanus***
American sand lance, 8 records in 2012 only. Smaller and inshore, semi-demersal species over sandy habitats; rarely captured in bottom trawl gear in Northern Gulf region. Difficult to identify to species unless examined minutely (number of lateral plicae).
Database: no action.
Analysis: merge with *A. dubius* to genus *Ammodytes*; use as pelagic.

696 ***Ammodytes* sp.**
Sand lances, 66 records. Captures mostly of 1-3 specimens and <10 g.
Database: no action.
Analysis: merge with records at species level; use as pelagic.

699 ***Anarhichas denticulatus***
Northern wolffish, one record at 355 m depth in 2012. Medium-sized specimen (0.5 m, 1.51 kg) of a large bentho-pelagic species.
Database: no action.
Analysis: demersal; exclude as rare for other analyses.

702 ***Anarhichas* sp.**
Unspecified wolffish, one record at 269 m depth in 2007. Very small specimen (8.6 g).
Database: no action.
Analysis: exclude.

709 Stichaeidae
Unspecified blennies, two records at 151 and 217 m depth, in 2007 and 2012. Small specimens: 7.9 and 2.4 g.
Database: no action.
Analysis: exclude.

715 *Lumpenus fabricii*
Slender eelblenny, three records of four large specimens in 2009 (stations 139, 140, 175). Captured at shallow depths (56, 68, and 110 m) and low temperatures (3.2, 2.6, and 1.6°C) at two sites near Minganie (north of Anticosti Island) and one in the Estuary (near Baie-Comeau). A common arctic species (also captured in the Southern Gulf). May be mistaken for snakeblenny (*Lumpenus lampretaeformis*). Was captured along with the other eelblenny species. A confirmed capture took place on another research survey (Louise Savard, IML) near Sept-Îles.
Database: review for confirmation.
Analysis: demersal; exclude as rare until confirmed.

718 *Anisarchus medius*
Stout eelblenny, 14 records of 269 individuals. May be mistaken for other eelblennies.
Database: no action.
Analysis: demersal.

725 Zoarcidae
Unspecified pouts, two records of small specimens at 66 and 217 m depth. Refers to undetermined species of *Lycodes*, *Lycenchelys*, or *Gymnelus viridis* (and not *Melanostigma atlanticum*).
Database: no action.
Analysis: exclude (too general, covering nearshore and deepwater species).

726 *Lycodes* spp.
Unspecified eelpouts, 22 records of small specimens, mostly from 80-130 m depth.
Database: no action.
Analysis: exclude (too general, covering nearshore and deepwater species).

733 *Lycodes polaris*
Polar eelpout, seven records (five in 2012) at depths of 69-138 m. May be mistaken for small specimens (usually < 20 cm in length) of *Lycodes lavalaei* (**728**).
Database: no action.
Analysis: demersal.

740 *Lycodes pallidus*
Pale eelpout, one record in 2009, at 110 m depth in the Estuary (near Baie-Comeau). Specimen of 1 g. Captured along with 30 *Lycodes lavalaei*. Assumed to be an error: name was mistakenly used before 2006 when referring to *Lycodes vahlii*. Arctic species not present in area.

Database: confirm then merge to *Lycodes vahlii* (**730**).
Analysis: exclude.

745 *Melanostigma atlanticum*
Atlantic softpout. Very small and gelatinous-bodied mesopelagic species. Frequently captured in bottom trawls during summer surveys. Belongs to eelpout family (Zoarcidae). Specimens may remain entangled in net and then recorded at subsequent stations.
Database: review low number captures from above 200 m and discard suspects.
Analysis: pelagic; exclude if <125 m.

747 *Lycenchelys* spp.
Unspecified eelpouts, four records, at depths >300 m. Very small specimens.
Database: review for confirmation, merge to another taxon or delete.
Analysis: exclude.

750 *Lycenchelys paxillus*
Common wolf eel, 25 records. Uniformly dark-coloured small species. May be mistaken for small specimens of *Lycodes terranovae* (**734**).
Database: no action.
Analysis: demersal.

752 *Lycenchelys verrillii*
Wolf eepout, frequent records. May be mistaken for small specimens of *Lycodes vahlii*.
Database: no action.
Analysis: demersal.

792 *Sebastes* sp.
Two species (*S. fasciatus, S. mentella*) are difficult to separate and are often recorded by genus. Considered demersal/benthopelagic.
Database: no action; may be exported at the species level (**794**, **796**) using the database variables of anal soft ray count and tow depth.
Analysis: demersal; use either as genus, or by species

794 *Sebastes mentella*
Deepwater redfish, frequent records. Tends to be found deeper than *S. fasciatus*.
Database: no action.
Analysis: demersal; only use if excluding **792**.

796 *Sebastes fasciatus*
Acadian redfish, frequent records.
Database: no action.
Analysis: demersal; only use if excluding **792**.

793 *Sebastes norvegicus*
Golden redfish, two records at 215 and 250 m depth. Distinctive (large, orange, absence of beak) and thus never placed in *Sebastes* sp. records (**792**). Pelagic-oceanic species.

Database: no action.
Analysis: demersal for total diversity; exclude as rare in other analyses.

797 *Helicolenus dactylopterus*
Blackbelly rosefish, one record in 2012. Southern species.
Database: no action.
Analysis: exclude.

808 Cottidae
Unspecified sculpins, one record in 2008, at 89 m depth. Small specimen (1.2 g).
Database: no action.
Analysis: exclude.

810 *Artediellus* spp.
Unspecified hookear sculpin, 55 records. Both species present were also recorded.
Database: no action.
Analysis: exclude; may be preferable to merge with species for some analyses.

813 *Triglops* sp.
Unspecified mailed sculpin, 12 records, at depths from 61 to 348 m. Both species present were also recorded.
Database: no action.
Analysis: exclude; may be preferable to merge with species for some analyses.

815 *Triglops nybelini*
Bigeye sculpin, three records in 2006. Distinct from common species, *Triglops murrayi*.
Database: no action; review capture in 2006.
Analysis: demersal; exclude as rare or merge to genus in some analyses.

817 *Myoxocephalus* sp.
Unspecified spiny sculpin. A capture without counts in 2006 (station 46, 0.95 kg) and one small specimen in 2008 (station 84, 0.5 g). Shallow water sites (60 and 76 m). Both *M. aenaeus* and *M. scorpius* were also caught at the station in 2006, while *M. scorpius* was caught in 2008. Small specimen in 2008 was not verified as *M. aenaeus* and thus was recorded to genus level.
Database: review capture in 2006; if >20 cm in length, move to *M. scorpius* (**819**).
Analysis: exclude.

818 *Myoxocephalus aenaeus*
Grubby sculpin, one record in 2006 at 60 m depth along with unspecified *Myoxcephalus* and *M. scorpius*. Three measured specimens for 692 g in a total capture of 1.45 kg. Inshore, small species (normally <15 cm length). Difficult to distinguish from small specimens of the large species *M. scorpius* (must examine for pore in gill arch).
Database: review length data for confirmation.
Analysis: exclude as rare for some analyses.

819 ***Myoxocephalus scorpius***
Shorthorn sculpin. Common species of inshore, rocky areas. Several records at >250 m depth may need review.
Database: no action.
Analysis: demersal.

820 ***Myoxocephalus octodecemspinosus***
Longhorn sculpin, three records, 49-79 m depth, in 2006 (11 at station 46), 2010 (6 at station 178), and 2011 (2 at station 71). Large species, more common in the south. Present in the Northern Gulf, but rarely captured. Often mistaken for *M. scorpius*, with which it was caught in 2006 and 2011.
Database: review data.
Analysis: demersal; exclude as rare or group to genus for some analyses.

823 ***Gymnocanthus tricuspis***
Arctic staghorn sculpin. Many records at at >250 m depth; may need review.
Database: no action.
Analysis: demersal.

829 ***Cottunculus microps***
Polar sculpin, eight records at >250 m depth. Deepwater solitary species.
Database: no action.
Analysis: demersal.

830 ***Icelus* sp.**
Unspecified sculpin, 19 records. Both species (*I. bicornis, I. spatula*) were also recorded.
Database: no action.
Analysis: exclude; may be preferable to merge with species for some analyses.

837 ***Ulcina olrikii***
Arctic alligatorfish, 30 records at <125 m and <1°C. Revised taxonomy, returned to genus *Aspidophoroides*. Rare capture on lower North Shore; common in Southern Gulf.
Database: no action.
Analysis: all uses.

844 ***Eumicrotremus spinosus***
Atlantic spiny lumpsucker. Small, common species.
Database: no action.
Analysis: demersal.

845 ***Eumicrotremus spinosus variabilis***
Placeholder name in the database (not actual taxon) for a pale and smooth male morphotype of Atlantic spiny lumpsucker (**844**), sometimes mistaken for the smooth lumpsucker *E. derjugini* (an arctic species). 16 records.
Database: no action; verify species in future or merge with 844.
Analysis: exclude as unconfirmed status.

849 *Cyclopterus lumpus*
Lumpfish. Benthopelagic species. Occasional captures on the North Shore at 100-200 m depth, with additional captures of juveniles along the Laurentian Channel at 200-400 m.
Database: no action.
Analysis: pelagic.

853 Liparidae
Unspecified snailfishes, five records at depths of 68-217 m. May refer to small specimens of *Liparis gibbus*.
Database: review for confirmation.
Analysis: exclude.

854 *Paraliparis* sp.
Unspecified bathydemersal snailfish, four records in 2006, 2007 and 2012 at depth (except in 2012: 96 m). Small specimens (<5 g).
Database: no action; review shallow water record.
Analysis: exclude.

856 *Paraliparis copei*
Blacksnout snailfish, 25 records. Deepwater species.
Database: no action.
Analysis: demersal.

857 *Liparis* sp.
Unspecified snailfishes, one small specimen of 0.6 g at 139 m. May refer to *L. gibbus*. Other species present but not recorded: *L. atlanticus* (inshore), *L. fabricii* (coldwater).
Database: no action; review for future confirmation.
Analysis: exclude.

862 *Liparis gibbus*
Variegated snailfish. Common species, highly variable colouration. Only local snailfish species that attains large sizes (20-30 cm).
Database: no action.
Analysis: demersal.

867 *Liparis coheni*
Cohen's snailfish, one specimen of 5 g in 2010 at 87 m in the Estuary. Taxonomic status may need review.
Database: no action; review for future confirmation.
Analysis: exclude.

874 *Paraliparis calidus*
Lowfin snailfish, 40 records. Deepwater species.
Database: no action.
Analysis: demersal.

891 ***Limanda ferruginea***
Yellowtail flounder, 25 records. Warmwater flatfish, occasional capture in region.
Database: no action.
Analysis: demersal.

966 ***Lophius americanus***
Monkfish, 25 records. Large, solitary benthic species.
Database: no action.
Analysis: demersal.

982 ***Cryptopsaras couesii***
Anglerfish, three records. Deepwater pelagic species. Solitary and rare. A second species of Ceratiidae, *Ceratias holboelli*, is also present (no captures for the period 2006–2012).
Database: no action.
Analysis: pelagic; exclude as rare or mesopelagic for some analyses.

NGSL database modifications for records 2006–2012

Fishes

Pelagic taxa (np = northern pelagics)
24 150 152 168 187 188 193 205 208 214 220 222 225 227 230 271 272 273 278 285 320 368 369 398 426 440 443 449 451 572 694 695 696 699 745 849 982
Exclude as uncertain:
271
Exclude as rare or mesopelagic:
152 168 187 193 205 208 214 220 222 225 227 230 271 272 273 278 285 368 369 440 699 982
Merge:
694 695 into 696 (*Ammodytes*)

Demersal taxa (nd = northern demersals)
12 15 27 90 91 94 100 102 373 430 436 438 439 441 442 444 447 453 454 455 461 478 700 701 702 709 710 711 715 716 717 718 721 725 726 727 728 730 733 734 740 746 747 750 752 792 793 797 808 809 810 811 812 813 814 815 817 818 819 820 823 829 830 831 832 836 837 838 844 845 853 854 856 857 862 865 867 874 889 890 891 892 893 966
Exclude as uncertain:
15 100 430 436 453 454 455 702 709 725 726 740 747 808 810 813 817 830 845 853 854 857 867
Exclude as rare or incidental:
15 373 442 715 793 797 818

Note: 792 may be split into 794 and 796 based on depth and anal fin soft ray count.

Invertebrates

Modifications to the corrected 2014 review, not applicable to original capture records.

Pelagic taxa (np = northern pelagics)
2040 2080 2095 2096 4753 4846 8114 8024 8028 8033 8035 8056 8057 8040
Change:
4846 (Octopoda) to 4853 (*Stauroteuthis syrtensis*)
Merge:
2080 2096 2096 into 2040
Exclude as rare or incidental:
1353 4770 4846 8024 8028 8033 8035 8040 8056

Benthic taxa (nb = northern benthos)
Capture database was updated in Jan. 2015. To be added to total list: 8173 (*Calocaris templemani*); 6 records up to 2012. Exclude as rare for analyses (see below).
Merge 4177 and 4179 into 4191 (*Similipecten greenlandicus*)
Move rare whelks to Buccinidae for analyses: 3519, 3564, 3578, 3583 into 3515

Add isopods from pelagic group but exclude from analyses: 6771 6791
Exclude as rare or incertain:
1341 2670 3248 3310 3248 3249 3445 3452 3519 3564 3578 3583 4008 4019 4102 4105
4126 4219 4268 4272 4352 4427 4498 7279 7691 8125 8173 8516 8521

Table A1. Summary of fish captures from the Northern Gulf of St. Lawrence 2006–2012, with survey code, names, total weight (kg) and abundance.

Code	Scientific name	Common name	Family	Weight (kg)	Count
12	Myxine glutinosa	Northern Hagfish	Myxinidae	1224	22521
15	Petromyzon marinus	Sea Lamprey	Petromyzontidae	0.1	1
24	Squalus acanthias	Spiny Dogfish	Squalidae	24.2	12
27	Centroscyllium fabricii	Black Dogfish	Etmopteridae	3423	4953
90	Amblyraja radiata	Thorny Skate	Rajidae	5980	12207
91	Malacoraja senta	Smooth Skate	Rajidae	1084	6407
94	Rajella fyllae	Round Skate	Rajidae	5.3	9
100	Leucoraja ocellata	Winter Skate	Rajidae	>0.1	1
102	Bathyraja spinicauda	Spinytail Skate	Arhynchobatidae	155	29
150	Clupea harengus	Atlantic Herring	Clupeidae	7541	23557
152	Alosa sapidissima	American Shad	Clupeidae	0.1	7
168	Xenodermichthys copei	Bluntsnout Smoothhead	Alepocephalidae	0.1	3
187	Mallotus villosus	Capelin	Osmeridae	14090	1283369
188	Osmerus mordax	Rainbow Smelt	Osmeridae	>0.1	1
193	Argentina silus	Atlantic Argentine	Argentinidae	3.6	46
205	Gonostomatidae	Bristlemouths	Gonostomatidae	0.1	67
208	Cyclothone microdon	Small-Toothed Bristlemouth	Gonostomatidae	>0.1	19
214	Maurolicus muelleri	Mueller's Pearlside	Sternoptychidae	>0.1	1
220	Sternoptychidae	Hatchetfishes	Sternoptychidae	>0.1	3
222	Polyipnus clarus	Slope Hachetfish	Sternoptychidae	>0.1	9
225	Argyropelecus gigas	Greater Silver Hatchetfish	Sternoptychidae	>0.1	1
227	Chauliodus sloani	Sloane's Viperfish	Stomiidae	0.2	4
230	Stomias boa	Boa Dragonfish	Stomiidae	0.1	5
271	Myctophiformes	Deepwater Fishes		>0.1	-
272	Myctophidae	Lanternfishes	Myctophidae	2.4	768
273	Notoscopelus	Common Lanternfish	Myctophidae	>0.1	4
278	Neoscopelus macrolepidotus	Glowingfish	Neoscopelidae	>0.1	2
285	Lampadena speculigera	Mirror Lanternfish	Myctophidae	0.1	3
320	Arctozenus risso	White Barracudina	Paralepididae	205	11688
368	Nemichthys scolopaceus	Atlantic Snipe Eel	Nemichthyidae	0.2	5
369	Serrivomer beanii	Stout Sawpalate	Serrivomeridae	0.1	2
373	Synaphobranchus kaupii	Northern Cutthroat Eel	Synaphobranchidae	0.6	5
398	Scomberesox saurus	Atlantic Saury	Scomberesocidae	2.1	54
426	Gasterosteus aculeatus	Threespine Stickleback	Gasterosteidae	1.3	564
430	Gadiformes	Codfishes		>0.1	1
436	Gadidae	Codfishes	Gadidae	0.1	4
438	Gadus morhua	Atlantic Cod	Gadidae	22871	43471
439	Gadus ogac	Greenland Cod	Gadidae	62	175
440	Micromesistius poutassou	Blue Whiting	Gadidae	0.4	1
441	Melanogrammus aeglefinus	Haddock	Gadidae	5	16
442	Microgadus tomcod	Atlantic Tomcod	Gadidae	0.1	2
443	Pollachius virens	Pollock	Gadidae	33	14
444	Phycis chesteri	Longfin Hake	Phycidae	486	4350
447	Urophycis tenuis	White Hake	Phycidae	2047	4264
449	Merluccius bilinearis	Silver Hake	Merlucciidae	86	508
451	Boreogadus saida	Arctic Cod	Gadidae	11	599

Code	Scientific name	Common name	Family	Weight (kg)	Count
453	Gaidropsarus	Threebeard Rocklings	Lotidae	0.8	27
454	Gaidropsarus ensis	Threebeard Rockling	Lotidae	>0.1	3
455	Gaidropsarus argentatus	Silver Rockling	Lotidae	>0.1	18
461	Enchelyopus cimbrius	Fourbeard Rockling	Lotidae	431	11338
478	Nezumia bairdii	Common Grenadier	Macrouridae	584	17626
572	Scomber scombrus	Atlantic Mackerel	Scombridae	30	202
694	Ammodytes dubius	Northern Sand Lance	Ammodytidae	>0.1	1
695	Ammodytes americanus	American Sand Lance	Ammodytidae	>0.1	8
696	Ammodytes	Sand Lances	Ammodytidae	0.3	119
699	Anarhichas denticulatus	Broadhead Wolffish	Anarhichadidae	1.51	1
700	Anarhichas lupus	Atlantic Wolffish	Anarhichadidae	675	1425
701	Anarhichas minor	Spotted Wolffish	Anarhichadidae	260	85
702	Anarhichas	Wolffishes	Anarhichadidae	>0.1	1
709	Stichaeidae	Shannies, Blennies	Stichaeidae	>0.1	2
710	Stichaeus punctatus	Arctic Shanny	Stichaeidae	0.5	59
711	Eumesogrammus praecisus	Fourline Snakeblenny	Stichaeidae	91	3928
715	Lumpenus fabricii	Slender Eelblenny	Stichaeidae	0.1	4
716	Lumpenus lampretaeformis	Snakeblenny	Stichaeidae	162	7022
717	Leptoclinus maculatus	Daubed Shanny	Stichaeidae	64	9542
718	Anisarchus medius	Stout Eelblenny	Stichaeidae	2	269
721	Cryptacanthodes maculatus	Wrymouth	Cryptacanthodidae	47	54
725	Zoarcidae	Eelpouts, Pouts, Wolf Eels	Zoarcidae	>0.1	4
726	Lycodes	Eelpouts	Zoarcidae	2.0	71
727	Lycodes esmarkii	Esmark's Eelpout	Zoarcidae	6	42
728	Lycodes lavalaei	Newfoundland Eelpout	Zoarcidae	245	2202
730	Lycodes vahlii	Vahl's Eelpout	Zoarcidae	341	6892
733	Lycodes polaris	Canadian Eelpout	Zoarcidae	4	179
734	Lycodes terraenovae	Atlantic Eelpout	Zoarcidae	9	51
740	Lycodes pallidus	Pale Eelpout	Zoarcidae	>0.1	1
745	Melanostigma atlanticum	Atlantic Soft Pout	Zoarcidae	44	13963
746	Gymnelus viridis	Fish Doctor	Zoarcidae	4	443
747	Lycenchelys	Wolf Eels	Zoarcidae	0.1	5
750	Lycenchelys paxillus	Common Wolf Eel	Zoarcidae	0.3	25
752	Lycenchelys verrillii	Wolf Eelpout	Zoarcidae	0.6	159
792	Sebastes	Rockfishes	Sebastidae	27883	265160
793	Sebastes norvegicus	Golden Redfish	Sebastidae	8	3
797	Helicolenus dactylopterus	Blackbelly Rosefish	Sebastidae	0.1	1
808	Cottidae	Sculpins	Cottidae	>0.1	1
809	Hemitripterus americanus	Sea Sculpin	Hemitripteridae	28	41
810	Artediellus	Hookear Sculpins	Cottidae	0.5	166
811	Artediellus atlanticus	Atlantic Hookear Sculpin	Cottidae	13	1901
812	Artediellus uncinatus	Arctic Hookear Sculpin	Cottidae	10	2197
813	Triglops	Mailed Sculpins	Cottidae	3	114
814	Triglops murrayi	Moustache Sculpin	Cottidae	236	21193
815	Triglops nybelini	Bigeye Sculpin	Cottidae	0.1	6
817	Myoxocephalus	Sculpins	Cottidae	0.9	1
818	Myoxocephalus aenaeus	Little Sculpin, Grubby	Cottidae	1.4	6
819	Myoxocephalus scorpius	Shorthorn Sculpin	Cottidae	557	1379
820	Myoxocephalus octodecemspinosus	Longhorn Sculpin	Cottidae	4	19
823	Gymnocanthus tricuspis	Arctic Staghorn Sculpin	Cottidae	149	3232
829	Cottunculus microps	Polar Sculpin	Psychrolutidae	0.1	11

Code	Scientific name	Common name	Family	Weight (kg)	Count
830	Icelus	Spatulate and Twohorn Sculpin	Cottidae	0.6	119
831	Icelus bicornis	Twohorn Sculpin	Cottidae	1.8	397
832	Icelus spatula	Spatulate Sculpin	Cottidae	4	450
836	Leptagonus decagonus	Atlantic Poacher	Agonidae	54	2854
837	Ulcina olrikii	Arctic Alligatorfish	Agonidae	0.4	190
838	Aspidophoroides monopterygius	Alligatorfish	Agonidae	12	2980
844	Eumicrotremus spinosus	Atlantic Spiny Lumpsucker	Cyclopteridae	42	2471
845	Eumicrotremus s. variabilis	Atlantic Spiny Lumpsucker	Cyclopteridae	0.4	28
849	Cyclopterus lumpus	Lumpfish	Cyclopteridae	187	311
853	Liparidae	Snailfishes	Liparidae	>0.1	10
854	Paraliparis	Snailfishes	Liparidae	>0.1	2
856	Paraliparis copei	Blacksnout Snailfish	Liparidae	0.4	51
857	Liparis	Snailfishes	Orchidaceae	>0.1	1
862	Liparis gibbus	Variegated Snailfish	Liparidae	77	1540
865	Careproctus reinhardti	Sea Tadpole	Liparidae	3	164
867	Liparis coheni	Gulf Snailfish	Liparidae	>0.1	1
874	Paraliparis calidus	Lowfin Snailfish	Liparidae	0.5	46
889	Hippoglossoides platessoides	American Plaice	Pleuronectidae	7090	78650
890	Glyptocephalus cynoglossus	Witch Flounder	Pleuronectidae	2460	22850
891	Limanda ferruginea	Yellowtail Flounder	Pleuronectidae	45	375
892	Reinhardtius hippoglossoides	Greeenland Halibut, Turbot	Pleuronectidae	35591	114921
893	Hippoglossus hippoglossus	Atlantic Halibut	Pleuronectidae	2454	489
966	Lophius americanus	Monkfish, Goosefish	Lophiidae	164	48
982	Cryptopsaras couesii	Triplewart Seadevil,	Ceratiidae	>0.1	1

APPENDIX 2: DATA STANDARDIZATION - SGSL TRAWL SURVEYS

Southern Gulf of St. Lawrence fishes

List of rare or problematic fish taxa from bottow trawl surveys over the 2006–2012 period, including remarks, suggested actions to database, and suitability for analyses.

11 *Melanogrammus aeglefinus*

Haddock, three records in 2007–2009. Large gadid. Southern species, uncommon in the Gulf. Catches were of large individuals at depths >150 m.
Database: no action.
Analysis: demersal; exclude as rare for some analyses.

14 *Merluccius bilinearis*

Silver hake, 27 records, usually of 1 specimen each, of small to medium size (40-400 g). Bentho-pelagic gadiforme, found in warmwater layers at depth (125-300 m) or near-surface (>50 m).
Database: no action.
Analysis: pelagic.

16 *Pollachius virens*

Pollock, four records, 14 specimens of medium-large size. Large bentho-pelagic gadid.
Database: no action.
Analysis: pelagic; exclude as rare for some analyses.

17 *Microgadus tomcod*

Atlantic tomcod. Small gadid. Two records. Common inshore species, not suitable for offshore spatial analysis.
Database: no action.
Analysis: demersal; exclude for spatial analyses.

23 *Sebastes* sp.

Redfishes. Frequent records. Comprises *Sebastes fasciatus* and *S. mentella,* and possibly also *S. norvegicus*. Demersal; small individuals (<12 cm) may be more pelagic.
Database: no action.
Analysis: demersal; may be preferable to separate juveniles for some analyses.

50 *Anarhichas lupus*

Striped wolffish, 35 records, wide depth distribution (40-300 m).
Database: no action.
Analysis: demersal.

51 *Anarhichas minor*

Spotted wolffish, five records of 1 individual each from 0.01 to 4.3 kg.
Database: no action; review along with *A. denticulatus.*
Analysis: demersal.

52 ***Anarhichas denticulatus***

Northern wolffish. 1 record in 2010. Very rare, bathypelagic species. Mottled colouring, may be mistaken for spotted wolffish *A. minor*.
Database: no action; review for future confirmation.
Analysis: demersal; exclude from all analyses.

61 ***Alosa sapidissima***

American shad, 27 records; mostly single inviduals, some in groups. Pelagic anadromous species, usually captured at <50 m, similar to the more-abundant alewife or gaspereau, *Alosa pseudoharengus* (**62**).
Database: no action.
Analysis: pelagic.

65 ***Salmo salar***

Salmon. Three records of large individuals (2-5 kg). Pelagic anadromous species.
Database: no action.
Analysis: pelagic; exclude as rare from spatial analyses.

88 ***Naucrates ductor***

Pilot fish. One record. Warmwater pelagic species.
Database: no action.
Analysis: pelagic, exclude as rare from spatial analyses.

110 ***Boreogadus saida***

Arctic cod, 10 records, 9 as single individuals, usually of <10 g and at bottom temperatures <1°C. Northern, coldwater gadid.
Database: no action.
Analysis: pelagic.

115 ***Gaidropsarus ensis***

Threebeard rockling. Three records. Demersal gadiformes. Small individuals caught at depths of 21, 61, 284 m. Silvery, pelagic juveniles may be mistaken for juveniles of *Enchelyopus cimbrius* (fourbeard rockling).
Database: no action.
Analysis: exclude.

138 ***Lampadena speculigera***

Mirror lanternfish. Three records. Mesopelagic. Myctophidae. Several individuals, from depths >350 m. Robust species, often captured in good condition and thus identifiable, unlike most myctophids (e.g., *Benthosema, Myctophum, Notoscopelus*).
Database: no action.
Analysis: pelagic; exclude as rare or mesopelagic.

150 Myctophidae
Lanternfishes. One record in 2011. Mesopelagic. Two individuals caught at depth of 336 m. Specimens are often fragile or in poor condition. May be mistaken for other lightfishes, including Neoscopelidae (Order Myctophiformes).
Database: no action.
Analysis: pelagic; exclude as rare or mesopelagic.

154 ***Cyclothone microdon***
Bristlemouth. Five records. Mesopelagic. Gonostomatidae. Very small individuals, captured at depths > 330 m.
Database: no action.
Analysis: pelagic; exclude as rare or mesopelagic.

159 ***Stomias boa ferox***
Dragon boa. Two records in 2010, at depths of 81 and 296 m. Deepwater stomiiforme.
Database: review record at 81 m.
Analysis: pelagic; exclude as rare or mesopelagic.

169 ***Chauliodus sloani***
Viperfish. Two records in 2007, at depths of 87 and 126 m. Deepwater stomiforme.
Database: review for confirmation.
Analysis: pelagic; exclude as rare or mesopelagic.

203 ***Leucoraja erinacea***
Little skate. One record in 2007 at 40 m depth, an individual of 626 g.
Database: review for confirmation.
Analysis: exclude.

205 ***Bathyraja spinicauda***
Spinytail skate. One record in 2011, at 368 m. Large specimen.
Database: no action.
Analysis: demersal; exclude as rare.

220 ***Squalus acanthias***
Spiny dogfish, nine records, seven as single individuals. Large size (>2 kg). Most captured in shallows of about 30 m; two records of 5 smaller individuals (<2 kg) from >250 m depth in 2006 and 2007 near black dogfish capture locations. Small schooling shark; southern species.
Database: review deepwater records.
Analysis: pelagic; exclude as rare for some analyses.

221 ***Centroscyllium fabricii***
Black dogfish, eight records at depths >250 m, with 1 to 3 individuals of 0.3-1.8 kg each. Smallest of Gulf sharks, often captured in large groups in the Laurentian Channel.
Database: no action.
Analysis: demersal; exclude as rare for some analyses.

230 *Lamna nasus*
Porbeagle. One record in 2007 of 66 kg. Very large pelagic shark. A seasonal warmwater visitor, along with the basking shark (*Cetorhinus maximus*). Also present is the resident coldwater demersal Greenland shark (*Somniosus microcephalus*). All three species have have been captured at least once on surveys and released (not usually recorded in catch).
Database: no action.
Analysis: pelagic; exclude as rare.

240 *Petryomyzon marinus*
Sea lamprey. One record in 2006. Anadromous parasitic species.
Database: no action.
Analysis: demersal; exclude as rare.

241 *Myxine glutinosa*
Northern hagfish. Frequent records at >250 m; several captures at 100-150 m. Individuals may become entangled in net mesh and recorded at subsequent stations.
Database: no action; review records when < 200 m depth.
Analysis: demersal.

303 *Myoxocephalus aenaeus*
Grubby (sculpin). Six records. Small species (generally <15 cm), difficult to distinguish from small specimens of *M. scorpius* (absence of pore on gill arch = *M. aenaeus*). One large specimen of 120 g in 2010.
Database: no action; review for future confirmation, to merge as *Myoxocephalus* sp.
Analysis: demersal; group to genus or exclude as rare for other analyses.

307 *Cottunculus microps*
Polar sculpin. One record at 155 m. Deepwater species.
Database: no action; review for future confirmation.
Analysis: demersal; exclude as rare.

313 *Icelus bicornis*
Sculpin. Four records, while the similar species *Icelus spatula* (**314**) had 225 records.
Database: no action; review for future confirmation.
Analysis: demersal; may be preferable to group as *Icelus* sp. for some analyses.

341 *Ulcina olrikii*
Arctic alligatorfish. Many captures between 50-80 m and <1°C. Unusual distribution for an arctic species, but confirmed to be valid. Name revised in 2012.
Database: update name to *Aspidophoroides olrikii*.
Analysis: demersal.

351 Agonidae f.
Family of alligatorfishes. One record in 2007. Three species, all accounted for in records.
Database: no action.
Analysis: demersal; exclude for all analyses.

364 *Gasterosteus wheatlandi*

Black-spotted stickleback. Two records in 2007 at 18 m depth. The threespine stickleback *Gasterosteus aculeatus* **(361)** had frequent records; the latter species can appear blackspotted due to infections with a microsporidian parasite and thus be misidentified.
Database: no action; review for future confirmation.
Analysis: pelagic; exclude as rare.

440 Ophichthidae f.

One record. Snake eels. Warmwater species.
Database: no action.
Analysis: demersal; exclude as rare.

500 *Liparis* sp.

Snailfishes. Six records for 10 g, at depths of 35-123 m. Uncertain juveniles.
Database: no action.
Analysis: demersal; exclude for all analyses.

501 *Cyclopterus lumpus*

Lumpfish, frequent records, ranging from small specimens at about 50 m depth nearshore to larger ones captured offshore down to 350 m. Semi-pelagic.
Database: no action.
Analysis: pelagic.

502 *Eumicrotremus spinosus*

Atlantic spiny lumpsucker, frequent records. Shallow-water species (<100 m); 1 was caught at 285 m (2007, set 85), while another was caught 2 stations prior at 83 m.
Database: no action.
Analysis: demersal.

512 *Liparis gibbus*

Variegated snailfish, frequent records at <100 m depth. Highly variable in colouration, may be mistaken for others in the genus; records may need review.
Database: no action.
Analysis: demersal.

504 *Liparis liparis*

Snailfish, one record in 2009 at 62 m of 8 g. European species; *L. gibbus* in N. America.
Database: review if may be considered as *Liparis* sp. or *Liparis gibbus*.
Analysis: demersal; exclude for all analyses.

505 *Liparis fabricii*

Gelatinous snailfish. Ten records, eight in 2006–2007. May be confused by the common name for *Careproctus reinhardti* (a more gelatinous-looking species). Similar to *Liparis gibbus*, but with dark peritoneum. Arctic species.
Database: no action; review for future confirmation.
Analysis: demersal.

520 *Careproctus reinhardti*
Sea tadpole. Thirteen records, at depths of 47-165 m. May be confused with other snailfishes. Small gelatinous fish, may be entangled in net mesh between stations.
Database: no action; review for confirmation due to shallow water captures.
Analysis: demersal.

600 *Anguilla rostrata*
American eel. One record in 2006. Migratory species.
Database: no action.
Analysis: demersal; exclude as rare.

603 *Lycenchelys verrillii*
Wolf eelpout, two records in 2010 and 2012, at 55 and 69 m, and 6 and 7 g. Deepwater zoarcid species. May be mistaken for *Lycodes vahlii* (mauve-blue colouration).
Database: no action.
Analysis: demersal; exclude as rare.

610 *Ammodytes dubius*
Northern sandlance, frequent records around 50 m depth. Offshore species, attains larger sizes than the inshore *A. americanus*.
Database: no action; confirm if possible to distinguish records from *A. americanus*
Analysis: pelagic.

616 *Gymnelus viridis*
Green ocean pout, frequent records. Inshore, coldwater, small zoarcid.
Database: no action.
Analysis: demersal.

619 *Lycodes terraenovae*
Atlantic eelpout. Two records in 2011, at depths 85-113 m. Small specimens. Deepwater species. May be confused in name and appearance with other eelpouts of *Lycodes* or *Lycenchelys* sp.
Database: no action; review for future confirmation.
Analysis: demersal; exclude as rare.

620 *Lycodes lavalaei*
Laval's eelpout. Frequent records. Large species. May be mistaken for other eelpouts, especially *L. polaris* when <20 cm.
Database: no action.
Analysis: demersal.

621 *Pholis gunnellus*
Rock gunnel. Three records at depths of 46, 59, and 336 m. Inshore species.
Database: review for future confirmation or delete record at 336 m.
Analysis: demersal; exclude as rare.

622 ***Leptoclinus maculatus***
Daubed shanny. Frequent records. May be mistaken for other eelblennies.
Database: no action.
Analysis: demersal.

623 ***Lumpenus lampretaeformis***
Snakeblenny. Frequent records. Large species; small specimens may be misidentified.
Database: no action.
Analysis: demersal.

624 ***Stichaeus punctatus***
Arctic shanny. Five records: four at 31-55 m and 7-10°C; one at 23 m and -0.5°C. Coldwater, inshore species.
Database: review for future confirmation (warm temperatures).
Analysis: demersal; exclude as rare for some analyses.

625 ***Ulvaria subbifurcata***
Radiated shanny, 11 records, most captured offshore, east of Gaspé on the Magdalen Shallows at 67 to 156 m and at temperatures <1°C, except for one inshore record at 23 m and 9°C in 2012. Abundant inshore species.
Database: review captures.
Analysis: demersal; exclude as rare for some analyses.

628 ***Lycodes polaris***
Polar eelpout, 13 records. Small zoarcid (<20 cm length). May be mistaken for the similar but larger sized species, *Lycodes lavalaei* (scaled vs naked body in *L. polaris*).
Database: no action.
Analysis: demersal.

630 ***Cryptacanthodes maculatus***
Wrymouth, 37 records, most at <50 m depth in Northumberland Strait. Solitary, large eel-like species. Burrows in soft sediment.
Database: no action; review of records from 100-250 m in the Laurentian Channel.
Analysis: demersal.

631 ***Lumpenus fabrici***
Slender eelblenny, six records. Large, coldwater species. Similar to *L. lampretaeformis*.
Database: no action; review for confirmation.
Analysis: demersal; exclude as rare for some analyses.

632 ***Lumpenus medius***
Stout eelblenny, frequent records. Current name: *Anisarchus medius*. May be mistaken for other eelblennies, in particular daubed shanny, *L. maculatus*.
Database: update name to *Anisarchus medius*; review for confirmation.
Analysis: demersal.

642 *Lycodes* sp.
Eelpouts. One record in 2009 at 94 m, for 12 specimens of 334 g.
Database: no action, review for future confirmation.
Analysis: demersal; exclude as rare, uncertain juveniles.

643 *Lycodes esmarki*
Esmark's eelpout. One record in 2007 at 285 m. Small specimen of 48 g. Large deepwater species, distinctive pale markings.
Database: no action.
Analysis: demersal, exclude as rare.

646 *Melanostigma atlanticum*
Atlantic softpout. Frequent records. Small mesopelagic species of the family Zoarcidae. Captured on summer bottom trawls because of demersal spawning. Elongated, gelatinous form, is readily entangled in fishing gear. Often captured at depths >200 m, shallow specimens were likely carried over from previous capture at a deeper location.
Database: review 13 suspect records from <200 m depth.
Analysis: pelagic.

647 *Lycodes vahlii*
Checker eelpout. Frequent records. Smaller specimens may be mistaken for *Lycenchelys verrillii* or other *Lycodes* sp.
Database: no action.
Analysis: demersal.

701 *Peprilus triacanthus*
Butterfish. Warmwater pelagic species, with 14 records in 2006, 2009, and 2011.
Database: no action.
Analysis: pelagic.

712 *Notolepsis rissoi kroyeri*
White barracudina (family Paralepididae), frequent records along the Laurentian Channel. Current name: *Arctozenus risso*. Mesopelagic species. Long, fragile body; specimens become entangled in gear and were recorded in sequential catches on the Magdalen Shallows. Historically, some unconfirmed cases of other species in family. For the period 2006–2012, all samples were assumed to be of *Arctozenus risso*.
Database: update taxonomic name: *Arctozenus risso*; review catches from <200 m.
Analysis: pelagic.

720 *Scomberesox saurus*
Atlantic saury. Warmwater pelagic species, with one record in 2011 at 34 m depth.
Database: no action.
Analysis: pelagic; exclude as rare.

770 ***Menidia menidia***
Atlantic silverside. Warmwater, pelagic inshore species, with 13 records from 2006–2010 in Northumberland Strait.
Database: no action.
Analysis: pelagic; exclude as inshore for some analyses.

868 ***Paraliparis calidus***
Lowfin snailfish. One record in 2010 at 350 m depth. Deepwater species.
Database: no action.
Analysis: demersal; exclude as rare.

Southern Gulf of St. Lawrence invertebrates

List of invertebrate taxa from bottom trawl surveys over the period 2006–2012, including remarks, suggested actions to database, and suitability for diversity or spatial analyses.

1800 Protochordata

Group for Chordata not belonging to Vertebrata (Tunicata and Thaliacea). Not a valid taxonomic group. One case in 2006 for 0.01 kg.
Database: no action.
Analysis: exclude.

1810 Tunicata

Group for tunicates. Assumed to refer to species of class Ascidicea (apart from *Boltenia ovifera* and *Halocynthia pyriformis*). Many cases over study area.
Database: rename to class Ascidiacea.
Analysis: use as a group under Ascidiacea, separate from the the two species of Pyuridae.

1821 *Ascidia* sp.

Solitary ascidian. Identified in some captures since 2009. Might include *Molgula* sp. Insufficient information to change status.
Database: no change.
Analysis: exclude or merge to class Ascidiacea (nominally as **1810)** for analyses.

1823 *Bolentia* sp.

Solitary ascidian. Common. Likely to be *Boltenia ovifera* (sea potato) and not *B. echinata* (sea cactus). Records from 150 m may need review.
Database: change to species *Boltenia ovifera*.
Analysis: all uses; belongs to class Ascidiacea, but is separate in catch.

1827 *Halocynthia pyriformis*

Solitary ascidian. Common. Sea peach.
Database: no action.
Analysis: all uses; belongs to class Ascidiacea, but is separate in catch.

1845 Thaliacea c.

Thaliacea. Salps. Pelagic gelatinous zooplankton. 1 case in 2011.
Database: no action.
Analysis: exclude.

1920 Bryozoans ectoprocta p.

Bryozoa. Colonial encrusting animals. Several cases. Diverse group. May be mistaken for Hydrozoa, or dead debris (calcareous remains). Insufficient information to change status.
Database: no action.
Analysis: exclude.

1930 Brachiopoda (phy.)
Brachiopoda. Lampshells. Superficially similar to Bivalvia (Mollusca). Two species are commonly reported in Northern Gulf: *Hemithiris psittacea* (dark valves), *Terebratulina septentrionalis* (pale valves). A third coldwater species, *Glaciarcula spitzbergensis*, was collected from Saguenay and is present in the IML museum collection.
Database: no action.
Analysis: diversity; include *Terebratulina* sp. **(1932)** for spatial analyses.

1932 *Terebratulina* sp.
One confirmed species in the genus: *Terebratulina septentrionalis*. Six records. Often mistaken for other species of juvenile bivalves or *H. psittacea*.
Database: change to species *Terebratulina septentrionalis* (AphiaID: 104056).
Analysis: diversity; merge to Brachiopoda **(1930)** for spatial analyses.

2100 Decapoda (ord.)
Decapoda: shrimps and crabs. Several species are under this taxonomic grouping.
Database: no action at present; future review may make individual species available.
Analysis: all uses.

2212 *Pandalus montagui*
Common soft-bottom shrimp species, but only a single record in survey database.
Database: no action at present; future review may make this species available.
Analysis: exclude.

2414 *Sclerocrangon boreas*
Common rocky-area shrimp species, but only a single record in survey database.
Database: no action at present; future review may make this species available.
Analysis: exclude.

2511 *Cancer borealis*
Rare inshore crab for the Gulf, more common to the south. Two records in database.
Database: no action.
Analysis: exclude as rare for spatial analyses.

2513 *Cancer irroratus*
Common inshore crab in the Gulf. Many records in database. A few captures at depth to be reviewed (>200 m).
Database: no action.
Analysis: all uses.

2520 *Hyas* sp.
Spider crabs. Two species: *Hyas araneus*, *Hyas coarctatus*. May be mistaken for each other especially in small specimens. A few records in the database.
Database: no action.
Action: exclude (use the available species records).

2521 ***Hyas coarctatus***
Arctic lyre crab. Some captures at depth (>150 m) may need review.
Database: no action.
Analysis: all uses.

2523 ***Lithodes maja***
Common deepwater crab. Some records at <100 m require review.
Database: no action.
Analysis: benthic.

2525 ***Lithodes/Neolithodes***
One record at depth in 2012.
Database: review information if available and merge to family Lithodidae or Decapoda.
Analysis: exclude.

2526 ***Chionoecetes opilio***
Snow crab. Usually found <100 m; a few captures were recorded at depth (300 m).
Database: no action.
Analysis: all uses.

2527 ***Hyas araneus***
Spider crab. Frequent records, two at >250 m to be reviewed (*Lithodes* or *Munidopsis*?).
Database: no action.
Analysis: all uses.

2550 ***Homarus americanus***
Lobster.
Database: no action.
Analysis: all uses.

2556 ***Munida valida***
Deepwater crab in south, species not recorded in Gulf. Capture at 57 m. Possibly mistaken for *Pagurus* sp. (proximity of species code in list, and depth).
Database: review information if available or merge to Decapoda.
Analysis: exclude.

2560 **Paguroidea s.f.**
Hermit crabs. Common in captures. One genus and three species likely: *Pagurus acadianus, P. arcuatus, P. pubescens.*
Database: change to *Pagurus* sp.
Analysis: use as genus *Pagurus* for all uses.

2566 ***Munidopsis curvirostra***
Deepwater galatheid crab, often in small groups. One specimen of 0.1 g at 250 m in 2010.
Database: no action.
Analysis: exclude as rare.

2800 Amphipoda o.
Amphipods. Common in records.
Database: no action.
Analysis: use for total diversity, exclude as too general for certain analyses.

2811 Gammaridae f.
Amphipod family. One record.
Database: no action.
Analysis: exclude as rare or merge to Amphipoda (**2800**).

2833 *Anonyx* sp.
Common amphipod. Six cases recorded in 2009 and 2010.
Database: no action.
Analysis: use for total diversity, merge to Amphipoda (**2800**) for some analyses.

2873 *Aeginina longicornis*
Caprellid (skeleton shrimp). One record in 2010.
Database: no action.
Analysis: exclude or merge to Amphipoda (**2800**).

2980 Isopoda o.
Isopods. 17 records in 2007-2011, from shallow (11 records, 40-80 m; Idoteidae?) and deepwater (6 records at 250-370 m: Aegidae? *Aega psora, Syscenus infelix*).
Database: no action; review for future confirmation if possible to place by family.
Analysis: exclude or use in benthos as Idoteidae (<100 m) and Aegidae (>100 m).

2990 Cirripedia (subcl./infracl.)
Barnacles. Seven records (2006–2012). Might include gooseneck (stalked) barnacles.
Database: no action; confirm if group excludes stalked barnacles.
Analysis: exclude (general and uncertain).

3000 Annelida p.
Segmented worms (Polychaeta, Oligochaeta). Five records (2009-2012).
Database: no action.
Analysis. exclude (general and uncertain).

3100 Polychaeta (cl.)
Common worms.
Database: no action.
Analysis: use for total diversity; may include individual species for certain analyses.

3131 *Nereis pelagica*
Large polychaete worm. Four records (2006–2009).
Database: no action.
Analysis: use for total diversity; merge to class Polychaeta for crtain analyses.

3133 Capitellidae f.
Small polychaete. One record.
Database: no action.
Analysis: use for total diversity; merge to class Polychaeta for analyses.

3149 ***Pectinaria granulata***
Tube-dwelling polychaete. One record.
Database: change to current synonym *Cistenides granulata* (AphiaID: 238377).
Analysis: use for total diversity; merge to class Polychaeta for analyses.

3150 Nereidae f.
Large polychaete. One record.
Database: no action.
Analysis: use for total diversity; merge to class Polychaeta for analyses.

3152 ***Scalibregma inflatum***
Large polychaete. Three records. May be mistaken for *Polyphysia crassa*.
Database: no action.
Analysis: use for total diversity; merge to class Polychaeta for analyses.

3161 ***Arenicola marina***
Large polychaete. Seven records.
Database: no action.
Analysis: use for total diversity; merge to class Polychaeta for analyses.

3200 ***Aphrodita hastata***
Very large polychaete worm. Recorded since 2011.
Database: change to current synonym *Aphroditella hastata*.
Analysis: use when including **3212**; is part of class Polychaeta, separate here.

3212 ***Aphrodita*** **sp.**
One species in genus. Frequent records.
Database: merge to species *Aphroditella hastata* **(3200)**.
Analysis: exclude.

3400 Acanthocephala p.
Parasite. One record.
Database: no action.
Analysis: exclude.

3451 ***Priapulus caudatus***
Rare, non-annelid worm. Three records.
Database: no action.
Analysis: use for total diversity; exclude as too rare for spatial anlayses.

3500 Polynoidae f.
Scaled worms (other than *Aphroditella hastata*).
Database: no action.
Analysis: use for total diversity; merge to class Polychaeta for certain analyses.

3700 *Sipunculus* sp.
Peanut worms (not Annelida). One record in 2012. May refer to phylum Sipuncula (*Golfingia* sp., *Phascolion* sp.).
Database: no action, unless revise classification if information available.
Analysis: exclude.

4000 Mollusca p.
Frequent records. Too general for use.
Database: no action.
Analysis: exclude.

4200 Gastropoda (cl.)
Frequent records. Might refer to gastropods other than in family Buccinidae.
Database: no action.
Analysis: all uses; may be too general for some analyses.

4209 Buccinidae f.
Whelks. Frequent records. May refer to *Buccinum* sp., *Colus* sp., or *Neptunea* sp.
Database: no action.
Analysis: use for total diversity and some analyses when merging species below.

4210 *Buccinum*
Whelks. Frequent records.
Database: no action.
Analysis: use for total diversity; may be merged to genus or family for some analyses.

4211 *Buccinum undatum*
Waved whelk. Common species. Frequent records.
Database: no action.
Analysis: use for total diversity; may be merged to genus or family for some analyses.

4212 *Buccinum scalariforme*
Whelk. Two records in 2012.
Database: no action.
Analysis: exclude or merge to genus or family for analyses.

4221 *Lunatia heros*
Moon snail. Current synonym: *Euspira heros*. Shallow water (captures from 34-110 m). May be mistaken for smaller, coldwater species in family Naticidae.
Database: no action, confirm if other species present.
Analysis: all uses.

4224 ***Margarites costalis***

Topshell. Records since 2010. Small, common gastropod, may be mistaken for related species *M. groenlandicus*. Formerly of family Trochidae (now superfamily Trochoidea).
Database: no action.
Analysis: use for total diversity; merge to genus for some analyses.

4225 ***Margarites groenlandica***

Topshell. Records since 2010. Small, common gastropod, may be mistaken for related species (*M. costalis*). Formerly of family Trochidae (now superfamily Trochoidea).
Database: correct name to *Margarites groenlandicus*.
Analysis: use for total diversity; merge to genus for some analyses.

4227 ***Neptunea decemcostata***

Whelk. Frequent records since 2010. Several older synonyms, including *Neptunea lyrata*. May be mistaken for similar *Neptunea despecta*.
Database: no action.
Analysis: use as *Neptunea* sp.

4228 ***Colus* sp.**

Whelk. Records since 2010. Species include *C. pubescens* (hairy shell) and *C. stimpsoni* (large shell). Some species have been revised (e.g., *C. spitzbergensis*, *C. kroyeri*) and no longer in the genus *Colus*. Small specimens may be mistaken for other gastropod species.
Database: no action.
Analysis: use for total diversity; use in family Buccinidae for some analyses.

4230 ***Aporrhais* sp.**

Pelican foot. Five records. Current names as species *Arrhoges occidentalis*. Small specimens with broken shell lip may be mistaken for *Colus*.
Database: update to current name.
Analysis: use for total diversity; exclude as too rare or uncertain for some analyses.

4240 ***Epitonium* sp.**

Small gastropod. Two records in 2012. Current name as species *Boreoscala greenlandica*.
Database: update to current name.
Analysis: exclude as too rare or uncertain for some analyses.

4250 **Littorinidae (fam.)**

Small inshore gastropods. Four records. May require confirmation as live or debris.
Database: no action.
Analysis: exclude as too rare or uncertain for some analyses.

4255 Trochidae f.

Older family name (now Margaritidae) for topshells such as *Margarites* sp.
Database: use (rename nominally) as *Margarites* sp.
Analysis: use as *Margarites* sp.; include **4259**, **4224**, **4225** for spatial analyses.

4259 ***Calliostoma occidentale***
Topshell. Four records in 2007. May be mistaken for *Margarites* sp.
Database: merge with *Margarites* and Trochidae.
Analysis: use as *Margarites* sp. (nominally under family **4255**).

4300 **Bivalvia (cl.)**
Frequent records, 16 records at over 200 m depth.
Database: no action. Review records if possible.
Analysis: use for spatial; may be preferable to exclude as too general for some analyses.

4303 ***Tellina* sp.**
One record in 2012, at 37 m depth. May refer to *Macoma* sp. (e.g., *M. calcarea*).
Database: no action.
Analysis: exclude.

4304 ***Arctica islandica***
Large clam. Frequent records.
Database: no action.
Analysis: all uses.

4306 ***Cuspidaria glacialis***
Two records. Other smaller species are present, unlikely to be captured.
Database: no action.
Analysis: use for diversity; exclude as rare for other analyses.

4307 ***Astarte undata***
One record in 2012. Several species present, may require open valve to verify.
Database: no action; may be merged to *Astarte* sp. in future.
Analysis: exclude as rare or merge to *Astarte* sp.

4310 **Cryptodonta (sup. Ord.)**
Thirty records. Unspecified bivalve clams, 16 to 343 m. Not a valid taxonomic category. May refer to order Myoida.
Database: clarify or merge to Bivalvia.
Analysis: exclude.

4312 ***Cyrtodaria siliqua***
Propellerclam. Several records.
Database: no action.
Analysis: all uses.

4316 ***Astarte* sp.**
Several records.
Database: no action.
Analysis: all uses (include *A. undata* **4307** in the genus).

4317 ***Spisula solidissima***
Large clam. Several records.
Database: no action.
Analysis: all uses.

4318 ***Mya arenaria***
Softshell clam, normally intertidal only. Several records at 30-90 m depth. May be debris (closed valves). Often mistaken for *Macoma calcarea*, more common at those depths.
Database: no action; needs future confirmation.
Analysis: exclude.

4319 ***Hiatella arctica***
Rock boring clam. Several records. May be mistaken for *Panomya norvegica*. Common name (softshell or long neck clam) in database suggests *Mya* or *Panomya.*
Database: no action; needs future confirmation.
Analysis: all uses.

4320 Pectinidae
Two records in 2006–2007, one at 30 m and the other at 150 m depth.
Database: no action; needs future confirmation.
Analysis: exclude.

4321 ***Placopecten magellanicus***
Giant sea scallop. Frequent records.
Database: no action.
Analysis: all uses.

4322 ***Chlamys islandicus***
Icelandic scallop. Frequent records. Two records of small species at depths >300 m are most likely of *Similipecten greenlandicus*.
Database: correct species name to *Chlamys islandica*. Review 2 cases for depth.
Analysis: all uses (excluding 2 deepwater records).

4323 ***Mercernaria mercenaria***
Hard clam. Three records in 2008–2009 only.
Database: no action; needs future confirmation.
Analysis: use for total diversity, exclude for spatial analyses.

4330 **Mytilidae (fam.)**
Mussels. Several records at depths < 80 m. Two record at >250 m. Might refer to *Mytilus*, *Modiolus*, or *Musculus* sp.
Database: no action; deepwater records need future confirmation.
Analysis: all uses.

4331 ***Mytilus edulis***
Common mussel. Three records in 2 years. Might include *Mytilus trossolus*.
Database: no action; review deepwater specimens if possible.
Analysis: use for diversity; merge to family for spatial analysis.

4332 ***Modiolus modiolus***
Horse mussel. Five records.
Database: no action.
Analysis: use for diversity; merge to family for spatial analysis.

4334 ***Musculus niger***
Black mussel. Several records. A smaller species, *Musculus discors*, is also present.
Database: no action.
Analysis: treat as genus for diversity; merge to family for spatial analysis.

4340 Cardiidae (fam.)
Unspecified cockle. May include family Carditidae. Several records, only one at >250 m.
Database: no action.
Analysis: exclude as uncertain.

4342 ***Clinocardium ciliatum***
Iceland cockle. Several records. Current name: *Ciliatocardium cilliatum ciliatum*.
Database: update to current name.
Analysis: use for diversity; merge to family for analysis.

4343 ***Serripes groenlandicus***
Greenland cockle. Two records.
Database: no action.
Analysis: exclude as rare.

4344 ***Venericardia borealis***
Heart cockle. One record. Current name: *Cyclocardia borealis*.
Database: update to current name.
Analysis: exclude as rare.

4345 ***Cerastoderma pinnulatum***
Northern dwarf cockle. One record. Current name: *Parvicardium pinnulatum*.
Database: update to current name.
Analysis: exclude as rare.

4351 ***Nuculana* sp.**
Nut clam. Nine records (7 in 2012).
Database: no action.
Analysis: use for total diversity; exclude as rare for other analyses.

4354 *Yoldia* sp.
One record in 2012.
Database: no action.
Analysis: exclude as rare.

4355 *Spisula polynyma*
Stimpson's surf clam. Three records. Current name: *Mactromeris polynyma*.
Database: update to current name.
Analysis: use for total diversity; exclude as rare for other analyses.

4400 Nudibranchia
Sea slugs. Frequent records.
Database: no action.
Analysis: use for total diversity; exclude as rare for other analyses.

4410 *Dendronotus* sp.
Bushyback sea slug. Several records in 2 years. One record at 200 m.
Database: no action.
Analysis: use for total diversity; merge to Nudibranchia for some analyses.

4511 *Illex illecebrosus*
Shortfin squid. Frequent records.
Database: no action.
Analysis: use as pelagic (along with jellyfish Scyphozoa, **8500**).

4512 *Loligo pealei*
Longfin squid. One record in 2011. Not yet confirmed in the Gulf.
Database: no action.
Analysis: exclude.

4521 Octopoda (ord.)
Octopus (unspecified). Frequent records, 25-375 m. Assumed to be of *Bathypolypus bairdii*. May include cirrate octopods (large deepwater, gelatinous species) or misidentified with bobtail squids (*Rossia* spp.).
Database: no action; needs future confirmation to exclude cirrate ocotopod species.
Analysis: exclude.

4522 *Semirossia tenera*
Bobtail squid. Frequent records. Southern species, assumed to be *Rossia* spp. in the Gulf. May be mistaken for octopus (*Bathypolypus bairdii*).
Database: name as *Rossia* spp.
Analysis: treat as *Rossia* spp. for all uses.

4524 *Bathypolypus arcticus*
Boreal spoonarm octopus. Northern species, not seen in Gulf. *Bathypolypus bairdii* is considered as the sole resident species in the Gulf.

Database: move to *Bathypolypus bairdii*.
Analysis: treat as *Bathypolypus bairdii*.

4525 *Rossia palpebrosa*
One record in 2011, 60 m depth. Valid species; difficult to distinguish from *R. megaptera*.
Database: no action.
Analysis: exclude.

4526 *Rossia megaptera*
One record in 2007, 70 m depth. Valid species; difficult to distinguish from *R. palpebrosa*. No sample count or weight.
Database: no action.
Analysis: exclude.

4529 Octopodidae
One record. Might be *Bathypolypus bairdii*.
Database: no action.
Analysis: exclude.

4700 Polyplacophora
Chitons. Several records. Assume species include *Tonicella* sp.
Database: no action.
Analysis: all uses.

5100 Pycnogonida (cl.)
Sea spiders. Nine records. Unknown which species.
Database: no action.
Analysis: all uses.

5101 Pycnogonidae (fam)
Sea spiders. Family excluding the common *Nymphon* sp. One record.
Database: no action.
Analysis: exclude or merge to class Pycnogonida.

5102 *Pycnogonum littorale*
Anemone sea spider. Distinctive species. Three records.
Database: update spelling to *Pycnogonum litorale*.
Analysis: use for total diversity; merge to class Pycnogonida for some analyses.

6000 Echinodermata
Echinoderms (unspecificied). One record in 2012.
Database: no action.
Analysis: exclude.

6100 Asteroidea (cl.)
Unspecified sea stars. Frequent records.
Database: no action.
Analysis: all uses.

6110 *Asterias* sp.
Unspecified sea stars. Frequent records. Normally nearshore. Unusual 10 records at depths >100 m. Assumed to be only 1 species present: *Asterias rubens*. May be mistaken for deeper water species *Leptasterias* sp., *Stephasterias albula*, *Urasterias lincki*.
Database: treat as family Asteriidae.
Analysis: all uses.

6111 *Asterias vulgaris*
Purple sea star. Current name: *Asterias rubens*. Frequent captures. Several records at depths >100 m.
Database: update name.
Analysis: all uses.

6113 *Leptasterias polaris*
Polar sea star. Frequent records. Large six-armed specimens are valid; smaller specimens may be of other species.
Database: no action; needs future confirmation for species or merge to family Asteriidae.
Analysis: use as species for total diversity, as genus **6114** for other analyses.

6115 *Ctenodiscus crispatus*
Mud star. Frequent records. Common in deep water, soft sediments.
Database: no action.
Analysis: all uses.

6117 *Hippasteria phyrigiana*
Horse star. Frequent records.
Database: no action.
Analysis: all uses.

6119 *Henricia sanguinolenta*
Blood star. Frequent records. Common species, but others may be present.
Database: no action.
Analysis: use as genus *Henricia* sp.

6120 *Solaster* sp.
Sun star. Several records. Variable colours. Assumed 1 species (*Solaster endeca*).
Database: no action.
Analysis: exclude or merge to **6121**.

6121 *Solaster endeca*
Purple sun star. Frequent records. Assumed to be the species present in genus.

Database: no action; review and include **6120** if confirmed.
Analysis: all uses.

6123 ***Crossaster papposus***
Spiny sun star. Frequent records.
Database: no action.
Analysis: all uses.

6125 ***Pteraster militaris***
Badge star. Frequent records. Three similar species (*P. militaris, P. pulvillus, P. obscurus*) in genus, and others in family Pterastidae.
Database: no action; needs future confirmation for species or merge to genus.
Analysis: use nominally as genus for all analyses.

6129 ***Poraniomorpha hispida***
Biscuit star. Three records. Common species; however, genus needs taxonomic review.
Database: no action; needs future confirmation for species or merge to genus.
Analysis: use nominally as genus for diversity; exclude as rare for other analyses.

6132 ***Leptasterias mulleri***
Muller's sea star. One record in 2007.
Database: no action.
Analysis: use for total diversity; merge to genus for other analyses.

6134 ***Leptasterias tenera***
Sea star. Three records.
Database: no action.
Analysis: use for total diversity; merge to genus for other analyses.

6135 ***Astrotecten duplicatus***
Sea star. Several records. Unlikely species, not recorded for the Gulf. Similar-looking to *Psilaster andromeda* in family Astropectinidae, which is present but not recorded here.
Database: correct spelling: *Astropecten duplicatus*; needs future confirmation of species.
Analysis: use nominally as *Psilaster andromeda*.

6200 Ophiuroidea (subcl./infracl.)
Unspecified brittlestar. Frequent records. Assumed to be restricted to order Ophiurida, not Euryalida (basket stars).
Database: no action.
Analysis: review if may use as order Ophiurida.

6211 ***Ophiopholis aculeata***
Daisy brittlestar. Colourful species common on hard substrates. One record in 2011.
Database: no action.
Analysis: exclude or merge to order Ophiurida for analyses.

6213 *Ophiura sarsi*
Sar's brittlestar. One records in 2012.
Database: correct spelling to *Ophiura sarsii*.
Analysis: exclude or merge to order Ophiurida for analyses.

6300 Gorgonocephalidae, asteronychidae
Basket stars. Frequent records. Two species in genus *Gorgonocephalus*.
Database: change from family to genus *Gorgonocephalus*.
Analysis: use nominally as genus.

6400 *Strongylocentrotus* sp.
Sea urchins. Frequent records. Two species: *S. droebachienseis*, *S. pallidus*.
Database: no action.
Analysis: all uses.

6413 *Brisaster fragilis*
Heart urchin. Several records. Deepwater species. Two records <100 m are suspect, possibly mistaken for other echinoderms.
Database: no action; review shallow records.
Analysis: exclude records at <100 m.

6500 Clypeasteroida (ord.)
Sand dollar. Frequent records. One species: *Echinarachnius parma*. Shallow water. Several records at depths >100 m to be reviewed.
Database: no action; review deep records.
Analysis: exclude records at >100 m.

6600 Holothuroidea (cl.)
Sea cucumbers (unspecified). Frequent records near 50 m.
Database: no action.
Analysis: all uses.

6713 *Psolus fabricii*
Scarlet psolus. Frequent records. Common inshore species on hard substrates.
Database: no action; review deepwater records.
Analysis: exclude 3 records at >150 m.

6715 *Psolus phantapus*
Brown psolus. Several records at shallow depths. Burrowing species.
Database: no action.
Analysis: all uses.

6718 *Molpadia* sp.
Deepwater burrowing holothurid. Two records in 2009 at <55 m.
Database: review records if possible (unlikely to be *Molpadia*).
Analysis: exclude.

6720 ***Molpadia musculus***
Deepwater burrowing holothurid. Two records in 2008 at <50 m.
Database: review records if possible (unlikely to be *Molpadia*).
Analysis: exclude.

7000 Parasites, round worms
Nematoda. Seven records.
Database: no action.
Analysis: exclude.

7500 Turbellaria c.
Flatworms. One record in 2009. May be mistaken for Nemertea (not recorded).
Database: no action; review for confirmation.
Analysis: exclude.

8000 Ctenophora, coelenterata, porifera
One record in 2011. Uncertain taxa.
Database: no action; review for confirmation.
Analysis: exclude.

8113 ***Pleurobrachia*** **sp.**
One record in 2010. Assumed species: *Pleurobrachia pileus*. Gelatinous zooplankton.
Database: no action.
Analysis: exclude.

8200 Coelenterata / cnidaria (phy.)
Phylum Cnidaria. Frequent records. Small captures. Unknown taxa.
Database: no action.
Analysis: exclude.

8208 Actinaria c.
Order for Sea anemones. One record in 2011. Other records likely in class Anthozoa (note 'c.' in database name).
Database: add records from class Anthozoa.
Analysis: all uses (when including records from Anthozoa **8300**).

8300 Anthozoa (cl.)
Sea anemone unspecified. Frequent records. Assumed to be order Actinaria.
Database: merge to order Actinaria **(8208)**.
Analysis: all uses as Actinaria.

8313 ***Stomphia coccinea***
Swimming anemone. Eight records in two years. May be mistaken for *Urticina*.
Database: no action; review for confirmation.
Analysis: use for total diversity; merge to order Actinaria **8208** for other analyses.

8316 *Hormathia* sp.
Nodular anemone. Two records (2010–2011). One species (*H. nodosa*) often mistaken for *Actinauge cristata*.
Database: no action; review for confirmation.
Analysis: use for total diversity; merge to order Actinaria **8208** for other analyses.

8317 *Bolocera* sp.
Deepwater anemone. Three records in 2011, only one at depth. Species assumed *Bolocera tuediae*. May be mistaken for *Liponema multicorne*.
Database: no action; review shallow water records.
Analysis: use as order Actinaria **8208**.

8318 *Pennatula borealis*
Sea pen. Current name: *Pennatula grandis*. Refers to all four species of order Pennatulacea in captures.
Database: rename records for order Pennatulacea.
Analysis: use nominally as Pennatulacea.

8319 *Actinauge verrilli*
Deeplet sea anemone. One record in 2012 at 244 m. Species in NW Atlantic is *Actinauge cristata* (*A. verrilli* is in the Pacific). Common species at depth. May be mistaken for *Hormathia nodosa* or *Actinostola callosa*.
Database: change name to *A. cristata*; review for confirmation.
Analysis: use as order Actinaria **8208**.

8321 *Epizoanthus incrustatus*
Anthozoan. One record in 2012 at 62 m.
Database: no action; review for confirmation.
Analysis: exclude.

8322 *Primnoa resedaeformis*
Large deepwater gorgonian coral, not previously reported present in the Gulf (Brunel et al. 1998). One record in 2007 at 298 m.
Database: no action; review for confirmation.
Analysis: exclude.

8324 *Duva multiflora*
Soft coral (family Nephtheidae). Frequent records. Also common are *Gersemia rubiformis* and *Drifa glomerata*, but not recorded.
Database: no action; review for confirmation.
Analysis: use nominally as family Nephtheidae.

8327 Soft Coral Unidentified
Alcyonacea. One record in 2011. Assumed of family Nephtheidae.
Database: no action; review for confirmation.
Analysis: exclude.

8329 ***Acanella arbuscula***
Deepwater gorgonian coral, not previously reported in the Gulf (Brunel et al. 1998). Six records in 2007 at <70 m.
Database: no action; review for confirmation.
Analysis: exclude.

8333 ***Paramuricea* sp.**
Deepwater coral, not previously reported in the Gulf (Brunel et al. 1998). Two records in 2007 at <100 m.
Database: no action; review for confirmation.
Analysis: exclude.

8366 ***Phakellia* sp.**
Sponge. Five records in 2011 only. Species was also recorded in 2011, unknown if same.
Database: no action; review for confirmation.
Analysis: exclude.

8400 Hydrozoa
Several records in 2011 and 2012. Possibly recorded under Cnidaria in other years.
Database: no action; review for confirmation.
Analysis: exclude.

8500 Scyphozoa (cl)
Jellyfish (pelagic medusa). Frequent records. May include hydrozoan medusa.
Database: no action.
Analysis: use as pelagic (along with shortfin squid, *Illex illecebrosus* **4511**).

8600 Porifera (phy.)
Sponges. Frequent records.
Database: no action; review for confirmation.
Analysis: all uses.

8610 ***Polymastia* sp.**
Several records.
Database: no action.
Analysis: use for total diversity; merge to phylum Porifera for other analyses.

8611 ***Polymastia mammilaris***
Common species. Several records.
Database: no action.
Analysis: use for total diversity; merge to phylum Porifera for other analyses.

8612 ***Tentorium semisuberites***
Small sponge. Frequent records.
Database: no action.
Analysis: use for total diversity; merge to phylum Porifera for other analyses.

8613 ***Suberites fucus***
Large sponge. Frequent records.
Database: no action.
Analysis: use for total diversity; merge to phylum Porifera for other analyses.

8614 ***Iophon* sp**.
Several records.
Database: no action.
Analysis: use for total diversity; merge to phylum Porifera for other analyses.

8616 ***Mycale lingua***
Frequent records.
Database: no action.
Analysis: use for total diversity; merge to phylum Porifera for other analyses.

8617 ***Biemna varianta***
Several records.
Database: no action.
Analysis: use for total diversity; merge to phylum Porifera for other analyses.

8618 ***Haliclona* sp**.
Two records.
Database: no action.
Analysis: use for total diversity; merge to phylum Porifera for other analyses.

8620 ***Halichondria sitiens***
Frequent records.
Database: no action.
Analysis: use for total diversity; merge to phylum Porifera for other analyses.

8621 ***Haliclona oculata***
Frequent records.
Database: no action.
Analysis: use for total diversity; merge to phylum Porifera for other analyses.

8623 ***Halichondria panacea***
Frequent records.
Database: no action.
Analysis: use for total diversity; merge to phylum Porifera for other analyses.

8624 ***Phakelia ventilabrum***
Several records.
Database: no action.
Analysis: use for total diversity; merge to phylum Porifera for other analyses.

SGSL trawl database modifications for records 2006–2012

Stations:
Exclude:
Rel. **678** in **2006**, Strata **440, 441, 442**: 16 records outside survey area
Total: 1131 records (survey total: 1147)

Fishes

Demersal taxa (sd)
Exclude as uncertain:
115 351 440 500 504 642
Exclude as rare:
17 88 203 205 240 303 307 313 600 603 619 621 643 868

Pelagic fish (sp)
14 16 52 60 61 62 63 64 65 70 88 110 138 150 154 159 169 220 230 361 364 501 610 646 701 712 720 770
Exclude as uncertain:
52 150
Exclude as rare or mesopelagic:
65 88 138 154 159 169 230 720

Benthic invertebrates (sb)
Taxon modifications:
4255 = "*Margarites* sp." (previously family Trochidae)
4522 = "*Rossia* sp." (two species are present, but not *Semirossia tenera*)
6110 = "Asteriidae" (*Asterias* sp. not needed; family level useful for doubtful species)
6135 = "*Psilaster andromeda*" (tentative ID; *Psilaster archaster* is not a species)
8318 = "Pennatulacea" (previously *Pennatula borealis*)
8324 = "Nephtheidae" (family, may be all under Alcyonacea)

Table A2a. Selected Southern Gulf of St. Lawrence benthic invertebrates, with survey code, scientific name, and regrouping. Shaded: group being used under a different taxon.

Code	Scientific name	Regrouped taxa
1810	Tunicata	**1821** (use as Class Ascidiacea)
1823	*Boltenia ovifera*	
1827	*Halocynthia pyriformis*	
1930	Brachiopoda	**1932**
2100	Decapoda	**2212, 2414, 2511, 2520, 2525, 2556, 2566**
2513	*Cancer irroratus*	
2521	*Hyas coarctatus*	
2523	*Lithodes maja*	
2526	*Chionoecetes opilio*	
2527	*Hyas araneus*	
2550	*Homarus americanus*	
2560	*Pagurus* sp.	
2800	Amphipoda	**2833, 2873**
3100	Polychaeta	**3131, 3133, 3149, 3150, 3152, 3161, 3500**
3200	*Aphroditella hastata*	**3212**
4200	Gastropoda	
4209	Buccinidae	
4210	*Buccinum* sp.	
4211	*Buccinum undatum*	
4221	*Euspira heros*	
4227	*Neptunea decemcostata*	
4255	Trochidae	**4224, 4225, 4259** (use as *Margarites* sp.)
4300	Bivalvia	
4304	*Arctica islandica*	
4312	*Cyrtodaria siliqua*	
4316	*Astarte* sp.	
4317	*Spisula solidissima*	
4319	*Hiatella arctica*	
4321	*Placopecten magellanicus*	
4322	*Chlamys islandica*	
4330	Mytilidae	**4331, 4332, 4334**
4342	*Ciliatocardium ciliatum*	
4351	*Nuculana* sp.	
4400	Nudibranchia	
4410	*Dendronotus* sp.	
4522	*Semirossia tenera*	
4524	*Bathypolypus bairdii*	
4700	Polyplacophora	
5100	Pycnogonida	**5100, 5102**
6100	Asteroidea	
6110	*Asterias* sp.	

Code	Scientific name	Regrouped taxa
6111	*Asterias rubens*	
6114	*Leptasterias* sp.	**6113, 6132, 6134**
6115	*Ctenodiscus crispatus*	
6117	*Hippasteria phrygiana*	
6119	*Henricia sanguinolenta*	
6121	*Solaster endeca*	
6123	*Crossaster papposus*	
6125	*Pteraster militaris*	
6200	Ophiuroidea	
6300	*Gorgonocephalus* sp.	
6400	*Strongylocentrotus* sp.	
6413	*Brisaster fragilis*	
6500	*Echinarachnius parma*	
6600	Holothuroidea	
6713	*Psolus fabricii*	
6715	*Psolus phantapus*	
8208	Actiniaria	**8208, 8313, 8316, 8317 8319**
8318	Pennatulacea	
8327	Alcyonacea	**8324** (soft corals)
8600	Porifera	
8610	*Polymastia* sp.	
8611	*Polymastia mammilaris*	
8612	*Tentorium semisuberites*	
8613	*Suberites ficus*	
8614	*Iophon* sp.	
8616	*Mycale lingua*	
8617	*Biemna variantia*	
8620	*Halichondria sitiens*	
8621	*Haliclona oculata*	
8623	*Halichondria panicea*	
8624	*Phakellia ventilabrum*	

Table A2b. SGSL taxa list with grouping (D=demersal, P=pelagic, M=mesopelagic, B=benthic), survey code, name, and occurences by year (2006–2012) and for total.

Group	Code	Name	06	07	08	09	10	11	12	Tot.
D	10	Gadus morhua	137	140	147	118	117	103	125	887
D	11	Melanogrammus aeglefinus		1	1	1				3
D	12	Urophycis tenuis	33	39	37	36	26	30	27	228
D	14	Merluccius bilinearis	1	4	1	6	2	5	8	27
P	16	Pollachius virens		1	1	1		1		4
D	17	Microgadus tomcod		1		1				2
D	23	Sebastes sp.	38	33	40	37	46	25	41	260
D	30	Hippoglossus hippoglossus	27	21	33	24	18	18	20	161
D	31	Reinhardtius hippoglossoides	36	46	49	40	36	35	34	276
D	40	Hippoglossoides platessoides	158	154	174	136	129	114	126	991
D	41	Glyptocephalus cynoglossus	33	32	45	31	24	21	35	221
D	42	Limanda ferruginea	82	88	95	81	71	70	92	579
D	43	Pseudopleuronectes americanus	47	45	49	46	46	40	46	319
D	50	Anarhichas lupus	8	6	4	3	4	6	4	35
D	51	Anarhichas minor			1	2	1		1	5
D	52	Anarhichas denticulatus					1			1
P	60	Clupea harengus	58	77	75	53	72	68	58	461
P	61	Alosa sapidissima	7	1	6		5	6	2	27
P	62	Alosa pseudoharengus	22	29	27	26	18	26	17	165
P	63	Osmerus mordax	26	28	25	27	24	26	19	175
P	64	Mallotus villosus	74	87	82	78	96	78	86	581
P	65	Salmo salar	1		1		1			3
P	70	Scomber scombrus	16	11	22	20	18	22	15	124
D	88	Naucrates ductor						1		1
P	110	Boreogadus saida	1	3	3	1		2		10
D	112	Phycis chesteri	5	3	7	6	6	6	3	36
D	114	Enchelyopus cimbrius	25	23	25	21	15	13	14	136
D	115	Gaidropsarus ensis					2	1		3
D	118	Gadus ogac	26	43	31	29	24	17	9	179
D	122	Tautogolabrus adspersus	10	14	11	15	7	6	6	69
M	138	Lampadena speculigera						2	1	3
D	143	Scophthalmus aquosus	8	14	7	10	5	9	8	61
M	150	Myctophidae							1	1
M	154	Cyclothone microdon				1		1	3	5
M	159	Stomias boa ferox					2			2
M	169	Chauliodus sloani		2						2
D	201	Amblyraja radiata	44	40	46	40	38	24	32	264
D	202	Malacoraja senta	19	14	17	14	13	15	8	100
D	203	Leucoraja erinacea		1						1
D	204	Leucoraja ocellata	7	7	9	5	2	3	6	39
D	205	Bathyraja spinicauda						1		1
P	220	Squalus acanthias	1	4	1	1	1		1	9
D	221	Centroscyllium fabricii	1	2	1	1		1	2	8
P	230	Lamna nasus		1						1
D	240	Petromyzon marinus	1							1
D	241	Myxine glutinosa	16	13	17	9	12	11	12	90
D	300	Myoxocephalus octodecemspinosus	43	53	48	45	43	26	35	293
D	301	Myoxocephalus scorpius	42	34	47	32	33	27	23	238
D	302	Gymnocanthus tricuspis	36	39	63	42	48	47	45	320
D	303	Myoxocephalus aeneus	1			2	3			6
D	304	Triglops murrayi	73	59	74	48	53	25	20	352
D	306	Artediellus uncinatus	21	24	27	21	28	11	13	145
D	313	Icelus bicornis				1	2	1		4
D	314	Icelus spatula	36	42	45	26	40	18	17	224
D	320	Hemitripterus americanus	25	22	21	29	22	13	18	150
D	340	Aspidophoroides monopterygius	62	66	74	59	66	39	53	419
D	341	Uleina olrikii	30	22	31	23	30	14	15	165

Group	Code	Name	06	07	08	09	10	11	12	Tot.
D	350	Leptagonus decagonus	39	35	42	34	23	27	17	217
D	351	Agonidae f.		1						1
P	361	Gasterosteus aculeatus	20	15	23	21	12	8	16	115
P	364	Gasterosteus wheatlandi		2						2
D	400	Lophius americanus	2	3		1	1			7
D	410	Nezumia bairdii	14	15	15	11	8	8	9	80
D	440	Ophichthidae f.					1			1
D	500	Liparis sp.	1	3		1			1	6
P	501	Cyclopterus lumpus	14	14	10	10	1	2	4	55
D	502	Eumicrotremus spinosus	29	20	33	27	16	7	10	142
D	504	Liparis liparis				1				1
D	505	Liparis fabricii	4	4			1	1		10
D	512	Liparis gibbus	40	41	43	34	48	23	37	266
D	520	Careproctus reinhardi	2	4	1	2	2	2		13
D	600	Anguilla rostrata	1							1
D	603	Lycenchelys verrilli					1		1	2
P	610	Ammodytes dubius	7	32	16	19	19	13	34	140
D	616	Gymnelis viridis	10	9	17	9	10		7	62
D	619	Lycodes terraenova						2		2
D	620	Lycodes lavalaei	63	52	72	36	28	22	24	297
D	621	Pholis gunnellus		2		1				3
D	622	Lumpenus lumpretaeformis	27	15	30	22	15	7	13	129
D	623	Leptoclinus maculatus	69	69	104	86	74	45	55	502
D	624	Stichaeus punctatus	1		3				1	5
D	625	Ulvaria subbifurcata		3	5	2			1	11
D	626	Eumesogrammus praecisus	39	27	32	18	28	13	28	185
D	628	Lycodes polaris					7	2	4	13
D	630	Cryptacanthodes maculatus	4	5	11	5	4	5	3	37
D	631	Lumpenus fabricii		4			1	1		6
D	632	Lumpenus medius	30	26	33	20	16	19	18	162
D	640	Zoarces americanus	10	9	10	6	4	2	3	44
D	642	Lycodes sp.				1				1
D	643	Lycodes esmarki		1						1
M	646	Melanostigma atlanticum	8	7	8	11	9	6	7	56
D	647	Lycodes vahlii	13	9	20	15	16	13	5	91
P	701	Peprilus triacanthus	5			7			1	13
P	712	Notolepis rissoi kroyeri	12	19	8	17	13	12	9	90
P	720	Scomberesox saurus						1		1
P	770	Menidia menidia	5	3	2	1	2			13
D	868	Paraliparis calidus					1			1
D	880	Artediellus atlanticus	46	45	52	31	31	15	20	240
B	1810	TUNICATA sp.	26	27	21	36	41	36	37	224
B	1821	Ascidia sp.				1	1	6	1	9
B	1823	Bolentia sp.	83	92	92	73	74	69	68	551
B	1827	Halocynthia pyriformis	2	2	16	6	1	4	2	33
B	1845	Thaliacea c.						1		1
B	1920	Bryozoans ectoprocta p.		18		8	23	19	3	71
B	1930	Brachiopoda (phy.)	6	11	14	7	9	5	5	57
B	1932	Terebratulina sp.			4		1	1		6
B	2100	Decapoda (ord.)	139	156	166	143	135	118	137	994
B	2212	Pandalus montagui						1		1
B	2414	Sclerocrangon boreas				1				1
B	2511	Cancer borealis		1	1					2
B	2513	Cancer irroratus	42	36	41	36	38	34	30	257
B	2520	Hyas sp.					8		1	9
B	2521	Hyas coarctatus	105	118	117	90	87	66	100	683
B	2523	Lithodes maja	15	12	12	15	10	9	9	82
B	2525	Lithodes/neolithodes							1	1
B	2526	Chionoecetes opilio	132	134	149	116	110	99	123	863
B	2527	Hyas araneus	63	58	63	52	69	43	56	404
B	2550	Homarus americanus	29	32	29	33	31	24	27	205

Group	Code	Name	06	07	08	09	10	11	12	Tot.
B	2556	Munida valida							1	1
B	2560	Paguroidea s.f.	90	76	89	60	72	58	67	512
B	2566	Munidopsis curvirostra					1			1
B	2800	Amphipoda o.		28	1	6	14	9	14	72
B	2811	Gammaridae f.		1						1
B	2833	Anonyx sp.				1	5			6
B	2873	Aeginina longicornis				1				1
B	2980	Isopoda o.		1	7	3	3	3		17
B	2990	Cirripedia (subcl. / infracl.)	1		1	1	2	2		7
B	3000	Annelida p.				1	1	2	1	5
B	3100	Polychaeta (cl.)	39	73	81	65	71	60	46	435
B	3131	Nereis pelagica	1		1	2				4
B	3133	Capitellidae f.		1						1
B	3149	Pectinaria granulata		1						1
B	3150	Nereidae f.			1					1
B	3152	Scalibregma inflatum		2		1				3
B	3161	Arenicola marina		4		3				7
B	3200	Aphrodita hastata						1	2	3
B	3212	APHRODITA sp.	12	12	9	8	13	7	5	66
B	3400	Acanthocephala p.			1					1
B	3451	Priapulus caudatus		1	1	1				3
B	3500	Polynoidae f.							19	19
B	3700	Sipunculus sp.							1	1
B	4000	Mollusca p.	82	118	128	94	84	54	65	625
B	4200	Gastropoda (cl.)	1	7	19	2	1	5	1	36
B	4209	Buccinidae f.	6	7	12	8	1	11	27	72
B	4210	BUCCINUM sp.	69	34	47	26	40	17	45	278
B	4211	Buccinum undatum	35	54	64	43	37	47	33	313
B	4212	Buccinum scalariforme							2	2
B	4221	Lunatia heros	7	8	4	2	9	2	13	45
B	4224	Margarites costalis					4	6	5	15
B	4225	Margarites groenlandica						2	1	3
B	4227	Neptunea decemcostata	1					8	30	39
B	4228	Colus sp.						1	2	3
B	4230	APORRHAIS sp.	1				1		3	5
B	4240	Epitonium sp.							2	2
B	4250	Littorinidae (fam.)		2	1	1				4
B	4255	Trochidae f.					3		5	8
B	4259	Calliostoma occidentale		4						4
B	4300	Bivalvia (cl.)	65	41	39	37	49	58	78	367
B	4303	Tellina sp.							1	1
B	4304	Arctica islandica	9	8	4	5	8	4	4	42
B	4306	Cuspidaria glacialis					1		1	2
B	4307	Astarte undata							1	1
B	4310	Cryptodonta (sup. Ord.)	9	4	9	2	3		3	30
B	4312	Cyrtodaria siliqua	3	1	5	3	1	1	8	22
B	4316	Astarte sp.		2		2	5	5	6	20
B	4317	Spisula solidissima	1	1	4	1		2		9
B	4318	Mya arenaria	1		5	2	1			9
B	4319	Hiatella arctica				1	1	2	2	6
B	4320	Pectinidae f.	1	1						2
B	4321	Placopecten magellanicus	16	9	8	10	7	5	2	57
B	4322	Chlamys islandicus	15	22	27	15	13	18	17	127
B	4323	Mercenaria mercenaria		1	2					3
B	4330	Mytilidae (fam.)	6	10	2	6	3	2	4	33
B	4331	Mytilus edulis			2				1	3
B	4332	Modiolus modiolus		1	1		2	1		5
B	4334	Musculus niger	1				4	4	1	10
B	4340	Cardiidae (fam.)	3	8	8	2	4	1		26
B	4342	Clinocardium ciliatum	6	2	9	8	8	8	13	54
B	4343	Serripes groenlandicus				1			1	2

Group	Code	Name	06	07	08	09	10	11	12	Tot.
B	4344	Venericardia borealis				1				1
B	4345	Cerastoderma pinnulatum			1					1
B	4351	Nuculana sp.	1				1		7	9
B	4354	Yoldia sp.							1	1
B	4355	Spisula polynyma					1	2		3
B	4400	Nudibranchia (ord.)	10	12	25	24	29	25	21	146
B	4410	Dendronotus sp.		6			14			20
P	4511	Illex illecebrosus	49	71	34	34	36	21	29	274
P	4512	Loligo pealei						1		1
B	4521	Octopoda (ord.)	8	3	15	4	5	2	3	40
B	4522	Semirossia tenera	9	14	6	4	5	8	3	49
B	4524	Bathypolypus arcticus	8	6	5	1		4	4	28
B	4525	Rossia palpebrosa						1		1
B	4526	Rossia megaptera		1						1
B	4529	Octopodidae f.				1				1
B	4700	Polyplacophora (cl.)	1	3	10	2	1	2	1	20
B	5100	Pycnogonida (cl.)	2				2	2	4	10
B	5101	Pycnogonidae o.					1			1
B	5102	Pycnogonum littorale				2			2	4
B	6000	Echinodermata p.							1	1
B	6100	Asteroidea (cl.)	10	6	14	10	7	9	4	60
B	6110	Asterias sp.	21	13	28	15	23	12	22	134
B	6111	Asterias vulgaris	18	18	14	12	5	1	6	74
B	6113	Leptasterias polaris	47	60	50	64	59	54	56	390
B	6115	Ctenodiscus crispatus	30	37	40	31	26	20	19	203
B	6117	Hippasteria phrygiana	15	31	22	15	17	14	8	122
B	6119	Henricia sanguinolenta	47	66	87	76	71	42	56	445
B	6120	Solaster sp.	54	1		6	4	1	6	72
B	6121	Solaster endeca	48	61	55	39	39	37	32	311
B	6123	Solaster papposus (=Crossaster papposus)	89	137	143	109	110	97	98	783
B	6125	Pteraster militaris	29	11	6	26	9	14	13	108
B	6129	Poraniomorpha hispida					2		1	3
B	6132	Leptasterias mulleri		1						1
B	6134	Leptasterias tenera		1			1			2
B	6135	Astrotecten duplicatus	1	1	1			3	3	9
B	6200	Ophiuroidea (subcl./infracl.)	43	99	84	77	81	60	82	526
B	6211	Ophiopholis aculeata						1		1
B	6213	Ophiura sarsi							1	1
B	6300	Gorgonocephalidae,asteronychidae	106	100	119	95	97	66	82	665
B	6400	Strongylocentrotus sp.	125	134	142	117	113	97	105	833
B	6413	Brisaster fragilis	5	5	10	7	5	4	4	40
B	6500	Clypeasteroida (ord.)	84	78	81	69	74	43	67	496
B	6600	Holothuroidea (cl.)	58	55	49	53	50	44	49	358
B	6713	Psolus fabricii	25	30	18	29	18	9	25	154
B	6715	Psolus phantapus			4	7	8	4	8	31
B	6718	Molpadia sp.				2				2
B	6720	Molpadia musculus			2					2
B	7000	Parasites,round worms					5	1	1	7
B	7500	Turbellaria c.				1				1
P	8113	Pleurobrachia sp.					1			1
P	8200	Coelenterata / cnidaria (phy.)	11	22	27	19	28	6	26	139
B	8208	Actinaria c.						1		1
B	8300	Anthozoa (cl.)	113	103	117	86	81	81	77	658
B	8313	Stomphia coccinea				2			6	8
B	8316	Hormathia sp.					1	1		2
B	8317	Bolocera sp.							3	3
B	8318	Pennatula borealis	18	32	26	30	28	21	12	167
B	8319	Actinauge verrillii							1	1
B	8321	Epizoanthus incrustatus							1	1
B	8322	Primnoa resedaeformis		1						1
B	8324	Duva multiflora	77	59	60	48	65	44	54	407

Group	Code	Name	06	07	08	09	10	11	12	Tot.
B	8327	Soft coral unidentified						1		1
B	8329	Acanella arbuscula		7						7
B	8333	Paramuricea sp.		2						2
B	8366	Phakellia sp.						5		5
B	8400	Hydrozoa c.					21	27		48
P	8500	Scyphozoa (cl.)	81	76	65	87	49	79	43	480
B	8600	Porifera (phy.)	73	34	17	31	23	30	18	226
B	8610	Polymastia sp.	2	2	1	5		8	1	19
B	8611	Polymastia mammilaris	2	6	1	6	4	2	2	23
B	8612	Tentorium semisuberites	10	6	15	9	7	3	3	53
B	8613	Suberites ficus	9	9	21	13	9	7	7	75
B	8614	IOPHON sp.	1	4	4	2	6		1	18
B	8616	Mycale lingua	22	29	26	26	14	13	14	144
B	8617	Biemna variantia	8	4	15	15	8	1	1	52
B	8618	Haliclona sp.						2		2
B	8620	Halichondria sitiens	8	7	9	10	2	4	2	42
B	8621	Haliclona oculata	27	28	40	39	27	26	12	199
B	8623	Halichondria panacea	10	13	11	7	13	15	10	79
B	8624	Phakellia ventilabrum	5	7	3	5	9	7	18	54

APPENDIX 3: DATA STANDARDIZATION - ZOOPLANKTON

Exclude distant station 90 from 2006
(longitude -59, in Cabot Strait

Retain original names
New column with "taxon" = updated name

Remove: sp., spp., spelling variations

Exclude copepod egg and larvae
oeufs, nauplii, Copepoda oeuf and nauplii

Exclude non-taxonomic general group:
Invertebrate (eggs)

Regroup (merge):
Euphausiacea = Euphausiidae
Euphausiacea eggs, larva = Euphausiidae
Medusae, Cnidaria <=2mm = Cnidaria
Ammodytes, Clupea harengus, Gadus morhua, Osteichthyes, Poisson = Actinopterygii (including eggs, larvae, juveniles)

Match taxon names using WoRMS Taxon Match
Update to currently valid synonym

Change species:
Anomalocera pattersoni (= *A. patersoni*) = *A. opalus* (NW Atlantic)

Update names:
Gaidius tenuispinus = *Gaetanus tenuispinus*
Mysidacea = Mysida
Oncaea borealis = *Triconia borealis*
Oncaea triconifera = *Triconia conifera*
Euchaeta norvegica = *Paraeuchaeta norvegica*
Eurytemora hirunoides = *Eurytemora affinis*
Pteropoda = mark as outdated (no change)
Sagitta elegans = *Parasagitta elegans*
Sagitta maxima = *Pseudosagitta maxima*
Sagitta sp. = Sagittidae (may be *Parasagitta* or *Pseudosagitta*)

Merge to genus (although species may be valid):
Paracalanus parvus = *Paracalanus* (although is likely the 1 species)
Calanus fin./glac. = *Calanus* sp. (then **exclude**--already covered by 3 species)

Remove general groups with only 1 record each:
NGSL: Amphipoda, Foraminifera, Calanoida, Cyclopoida
(not done for SGSL because there were far fewer stations)

Suggested for merging (genus records, likely of 1 species; not done in this exercise)
Beroe = *Beroe cucumis*
Fritillaria = *Fritillaria borealis*
Limacina = *Limacina helicina*

Other records should also be reviewed (not done in this exercise), for example:
Acartia clausi = *Acartia hudsonica*
Halopsis = *Halopsis ocellata*
Podon = *Podon leuckartii* (to confirm)

APPENDIX 4: DATA STANDARDIZATION - SEABIRDS

Table A4: Seabird taxon occurrences in grid cells for for northern (N) and southern (S) regions. *Note: 1 occurrence may refer to American black duck (not strictly marine).

Code	**Name**	**N**	**S**
ALSP	Alcidae	1	4
CAME	Merginae	1*	1
COAI	*Phalacrocorax auritus*	3	7
COSP	*Phalacrocorax* sp.	2	
EIDU	*Somateria mollissima*	4	
FOBA	*Morus bassanus*	285	215
FUBO	*Fulmarus glacialis*	51	13
GOAC	*Larus glaucoides*		1
GOAR	*Larus argentatus*	186	65
GOBC	*Larus delawarensis*	7	
GOBR	*Larus fuscus*		3
GOMA	*Larus marinus*	90	55
GOSP	Laridae	20	4
GRCO	*Phalacrocorax carbo*	8	4
GRLA	*Stercorarius skua*		2
GUBR	*Uria lomvia*	1	
GUMA	*Uria aalge*	31	2
GUMI	*Cepphus grylle*	3	2
GUNO	*Chlidonias niger*	2	
GUPP	*Alca/Uria*	3	
LAPA	*Stercorarius parasiticus*	3	3
LAPO	*Stercorarius pomarinus*	1	
LASP	*Stercorarius* sp.	1	1
MABR	*Melanitta fusca*	1	2
MAMO	*Fratercula arctica*	13	
MANO	*Melanitta nigra*	1	2
MENA	*Alle alle*	21	7
MOBO	*Chroicocephalus philadelphia*		6
MORI	*Chroicocephalus ridibundus*		1
MOTR	*Rissa tridactyla*	88	23
OCCB	*Oceanodroma leucorhoa*	15	3
OCSP	Hydrobatidae	9	4
OCWI	*Oceanites oceanicus*	45	2
PEPI	*Alca torda*	15	
PHBE	*Phalaropus lobatus*	6	8
PHBL	*Phalaropus fulicarius*		1
PHSP	*Phalaropus* sp.	1	4
PHWI	*Phalaropus tricolor*		1
PLCA	*Gavia stellata*	2	1
PUAN	*Puffinus puffinus*	3	2
PUFU	*Puffinus griseus*	19	2
PUMA	*Puffinus gravis*	98	18
PUSP	*Puffinus* sp.	2	
STAR	*Sterna paradisaea*	4	4
STPI	*Sterna hirundo*	15	6
STSP	Sternidae	4	5